Minerals Yearbook
1968

Volume III

AREA REPORTS: DOMESTIC

U. S. DEPARTMENT OF THE INTERIOR
March 3, 1849

Prepared by staff of the
BUREAU OF MINES

UNITED STATES DEPARTMENT OF THE INTERIOR • Walter J. Hickel, Secretary

BUREAU OF MINES • John F. O'Leary, Director

Created in 1849, the Department of the Interior—America's Department of Natural Resources—is concerned with the management, conservation, and development of the Nation's water, wildlife, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

As the Nation's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that parks and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States—now and in the future.

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Foreword

The 1968 Minerals Yearbook provides a record of performance of the world's minerals industries during the year of review, with sufficient background information to interpret the year's developments.

Volume I–II, Metals, Minerals, and Fuels, contains chapters on the metal, nonmetal, and mineral fuel commodities essential to the domestic economy. In addition, it includes a general review chapter on these industries, a statistical summary, and chapters on employment and injuries, and technologic trends.

Volume III, Area Reports: Domestic, contains chapters covering each of the 50 States, the U.S. island possessions in the Pacific Ocean and the Caribbean Sea, the Commonwealth of Puerto Rico, and the Canal Zone. This volume also has a statistical summary chapter, identical with that in Volume I–II, and a chapter on employment and injuries.

Volume IV, Area Reports: International, presents the latest available mineral statistics for more than 130 foreign countries and areas and discusses the importance of minerals to the economies of these nations. A separate chapter reviews minerals and their relationship to the world economy.

The Minerals Yearbook is the most comprehensive publication of its kind available and the Bureau will continue its efforts in the years ahead to increase the Yearbook's value to its many users. Toward that end, the constructive comments and suggestions of readers are invited.

JOHN F. O'LEARY, *Director*

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Acknowledgments

In preparing this volume of the Minerals Yearbook, the Bureau of Mines was assisted in the collection of statistical data and mineral-industry information by various State agencies, through cooperative agreements. Many State chapters were reviewed by staff members of these agencies, and in some instances the staff members collaborated in preparing the chapters and are shown as coauthors. For this assistance acknowledgment is made to the following cooperating organizations:

Alabama: Geological Survey of Alabama.

Alaska: Division of Mines and Geology of the Alaska Department of Natural Resources.

Arizona: Arizona Bureau of Mines; and Oil and Gas Conservation Commission.

Arkansas: Arkansas Geological Commission; Arkansas Oil and Gas Commission; Department of Revenue.

California: Division of Mines and Geology, California Department of Conservation.

Colorado: The Oil and Gas Conservation Commission; Coal Mines Inspections Department; and the Colorado Bureau of Mines.

Connecticut: Connecticut Geological and Natural History Survey.

Delaware: Delaware Geological Survey.

Florida: Division of Geology, Florida Board of Conservation.

Georgia: Department of Mines, Mining, and Geology, State Division of Conservation.

Hawaii: Hawaii Department of Land and Natural Resources.

Idaho: Idaho Bureau of Mines and Geology.

Illinois: Illinois State Geological Survey.

Indiana: Geological Survey, Indiana Department of Natural Resources.

Iowa: Iowa Geological Survey.

Kansas: Conservation Division, State Corporation Commission; and State Geological Survey of Kansas.

Kentucky: Kentucky Geological Survey.

Louisiana: Louisiana Geological Survey; Louisiana Department of Conservation; Department of Labor, Division of Employment Security; and Department of Commerce and Industry.

Maine: Maine Geological Survey, Department of Economic Development.

Maryland: Maryland Geological Survey.

Michigan: Geological Survey Division, Michigan Department of Natural Resources.

Minnesota: Minnesota Geological Survey.

Mississippi: Mississippi Geological, Economic, and Topographical Survey; Mississippi State Oil Gas Board; Oil and Gas Severance Tax Division, Mississippi State Tax Commission; and Mississippi Employment Security Commission.

Missouri: Missouri Geological Survey and Water Resources, Department of Business Administration.

Montana: Montana Bureau of Mines and Geology; The Oil and Gas Conservation Commission.

Nebraska: Conservation and Survey Division, University of Nebraska; and Nebraska Oil and Gas Conservation Commission.

Nevada: Nevada Bureau of Mines.

New Hampshire: New Hampshire Department of Resources and Economic Development.

New Jersey: Bureau of Geology and Topography, New Jersey Division of Resource Development.

New Mexico: Oil and Gas Accounting Commission.

New York: Geological Survey—New York State Museum and Science Service.

North Carolina: Division of Mineral Resources, Department of Conservation and Development.

North Dakota: State Geological Survey of North Dakota.

Oklahoma: Oklahoma Geological Survey; Oil and Gas Conservation Department, Oklahoma Corporation Commission; and Gross Production Division, Oklahoma Tax Commission.

Oregon: Oregon Department of Geology and Mineral Industries.

Pennsylvania: Pennsylvania Bureau of Topographic and Geologic Survey.

Puerto Rico: Mineralogy and Geology Section, Economic Development Administration, Commonwealth of Puerto Rico.

South Carolina: South Carolina Division of Geology, State Development Board.

South Dakota: South Dakota State Geological Survey.

Tennessee: Tennessee Division of Geology, Department of Conservation.

Texas: Bureau of Economic Geology, The University of Texas; Oil and Gas Division, Railroad Commission of Texas; Oil and Gas Division, State Comptroller of Public Accounts.

Utah: Utah Geological and Mineralogical Survey; and Oil and Gas Conservation Commission.

Virginia: Virginia Division of Mineral Resources.

Washington: Washington Division of Mines and Geology, Department of Natural Resources.

West Virginia: West Virginia Geological and Economic Survey.

Wisconsin: Geological and Natural History Survey.

Wyoming: Geological Survey of Wyoming; and Oil and Gas Conservation Commission.

Except for the statistical summary and injury experience and worktime chapters, this volume was prepared by the staffs of the following Bureau of Mines Mineral Resource Offices under the direction of—Mark L. Wright, Albany, Oreg.; Floyd D. Everrett, Bartlesville, Okla.; Murphy E. Hawkins, Dallas, Tex.; Ottey M. Bishop, Denver, Colo.; Robert L. Thorne, Juneau, Alaska; Robert D. Thomson, Knoxville, Tenn.; Wesley Grosh, Twin Cities, Minn.; Joel Van Sant, Pittsburgh, Pa.; Donald R. Irving, San Francisco, Calif.; Richard Appling, Spokane, Wash.

The manuscripts upon which this volume was based were reviewed by the Minerals Yearbook staff under the direction of Kathleen J. D'Amico to insure statistical consistency among the tables, figures, and text between this volume and volume I–II, and between this volume and those of former years.

Minerals Yearbook compilations are based largely on facts provided by the mineral industries. The willing contribution, by both companies and individuals, of these essential data is gratefully acknowledged.

ALBERT E. SCHRECK
Editor-In-Chief, Minerals Yearbook

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Statistical Summary

By Kathleen J. D'Amico [1]

This summary appears in Minerals Yearbook volumes I–II, and III, which cover mineral production in the United States, its island possessions, the Canal Zone, and the Commonwealth of Puerto Rico, as well as the principal minerals imported into and exported from the United States. The sections of this chapter and the area chapters in volume III contain further details on production. A summary table comparing world and U.S. mineral production also is included.

Mineral production may be measured at any of several stages of extraction and processing. The stage of measurement used in the chapter is normally what is termed "mine output." It usually refers to minerals in the form in which they are first extracted from the ground, but customarily includes for some minerals the product of auxiliary processing operations at or near mines.

Because of inadequacies in the statistics available, some series deviate from the foregoing definition. The quantities of gold, silver, copper, lead, zinc, and tin are recorded on a mine basis (as the recoverable content of ore sold or treated). The values assigned to these quantities, however, are based on the average selling price of refined metal, not the mine value. Mercury is measured as recovered metal and valued at the average New York price for metal.

The weight or volume units shown are those customary in the particular industries producing the respective commodities. No adjustment has been made in dollar values for changes in purchasing power of the dollar.

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[1] Statistical officer, Minerals Yearbook.

Table 1.—Value of mineral production[1] in the United States, by mineral groups

(Millions)

Year	Mineral fuels	Nonmetals (except fuels)	Metals	Total [2]
1964	$13,623	$4,623	$2,366	$20,612
1965	14,047	4,933	2,544	21,524
1966	[r] 15,088	5,176	2,703	[r] 22,968
1967	[r] 16,195	[r] 5,206	2,333	[r] 23,734
1968	16,820	5,452	2,703	24,974

[r] Revised.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Data may not add to total shown because of independent rounding.

Table 2.—Mineral production[1] in the United States

Mineral	1965		1966		1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Mineral fuels:								
Asphalt and related bitumens (native):								
Bituminous limestone and sandstone and gilsonite short tons	1,911,664	$9,461	2,041,271	$8,438	1,866,666	$8,136	1,786,840	$8,127
Carbon dioxide, natural (estimate) thousand cubic feet	1,173,676	152	1,140,907	153	1,142,374	165	1,118,027	176
Coal:								
Bituminous and lignite [2] thousand short tons	512,088	2,276,022	533,881	2,421,293	552,626	2,555,377	545,245	2,546,340
Pennsylvania anthracite do	14,866	122,021	12,941	100,663	12,256	96,160	11,461	97,245
Helium:								
Crude thousand cubic feet	3,566,734	39,848	3,654,700	41,556	3,697,300	42,800	3,788,400	44,700
Grade A do	819,100	28,880	951,400	32,541	1,015,000	29,657	1,066,400	28,855
Natural gas million cubic feet	16,039,753	2,494,542	r 17,206,628	r 2,702,759	18,171,325	2,898,741	19,322,400	3,168,688
Natural gas liquids:								
Natural gasoline and cycle products thousand 42-gallon barrels	173,525	494,354	179,248	r 520,685	187,840	r 546,927	199,049	571,679
LP gases do	268,080	417,249	288,912	527,228	326,616	632,994	351,262	552,335
Peat short tons	603,746	6,080	605,858	6,501	619,687	6,768	619,161	7,230
Petroleum (crude) thousand 42-gallon barrels	2,848,514	8,158,299	r 3,027,763	r 8,726,423	[3] 3,216,715	[3] 9,377,516	3,329,042	9,794,826
Total mineral fuels	XX	14,047,000	XX	r 15,088,000	XX	r 16,195,000	XX	16,820,000
Nonmetals (except fuels):								
Abrasive stones [4] short tons	3,608	$432	3,806	$515	2,701	$574	3,141	$629
Asbestos do	118,275	10,162	125,928	11,056	123,189	11,102	120,690	10,406
Barite thousand short tons	852	10,192	947	11,259	962	11,604	927	13,706
Boron minerals do	807	64,180	866	68,209	955	74,130	1,026	79,827
Bromine thousand pounds	328,115	77,259	326,498	78,888	349,757	85,391	362,452	86,787
Calcite (optical grade) pounds	(5)	(5)	(5)	(5)	----------	----------	----------	----------
Calcium-magnesium chloride short tons	(5)	(5)	(5)	(5)	608,965	11,983	(5)	(5)
Cement:								
Portland thousand 376-pound barrels	366,802	1,154,448	373,091	1,162,984	365,570	1,148,208	388,525	1,227,942
Masonry thousand 280-pound barrels	23,260	65,979	22,367	68,407	21,700	62,168	23,167	66,259
Natural and slag thousand 376-pound barrels	279	1,027	109	415	94	360	86	332
Clays thousand short tons	55,126	204,982	56,713	221,714	54,664	228,987	57,233	246,898
Emery short tons	10,720	204	11,102	210	(5)	(5)	(5)	(5)
Feldspar long tons	624,598	6,263	655,452	7,020	615,397	7,086	667,679	8,265
Fluorspar short tons	240,982	10,889	253,068	10,841	295,643	13,164	252,411	11,656
Garnet (abrasive) do	19,330	1,717	21,952	2,092	20,494	1,849	22,136	1,922
Gem stones (estimate)	NA	2,218	NA	2,487	NA	2,430	NA	2,497
Gypsum thousand short tons	10,033	37,875	9,647	35,681	9,393	34,883	10,018	36,775
Lime do	16,794	232,939	18,057	239,588	[3] 17,985	[3] 240,216	18,687	249,639
Magnesium compounds from sea water and brine (except for metals) short tons, MgO equivalent	687,857	47,197	651,187	46,690	544,428	r 41,883	525,210	43,449
Mica:								
Scrap short tons	120,255	3,468	113,133	3,733	118,503	2,876	125,323	3,014
Sheet pounds	716,086	185	4,500	1	20,500	(5)	15,000	(5)

Perlite .... short tons	392,384	3,352	404,160	3,907	418,001	3,978	427,574	4,221
Phosphate rock .... thousand short tons	29,482	193,828	39,044	261,092	39,770	265,947	41,251	250,692
Potassium salts ... thousand short tons, K₂O equivalent	3,140	129,767	3,320	122,210	3,299	105,318	2,722	75,664
Pumice .... thousand short tons	3,371	6,550	3,218	6,765	3,446	5,131	3,580	5,570
Pyrites .... thousand long tons	875	5,333	873	5,088	861	7,943	872	(5)
Salt .... thousand short tons	34,687	215,699	36,463	229,985	38,946	251,210	41,274	272,275
Sand and gravel .... do	908,049	957,416	934,481	984,982	[r] 907,045	[r] 981,748	917,789	1,020,386
Sodium carbonate (natural) .... short tons	1,494,105	34,717	1,737,511	40,674	[r] 1,726,071	40,539	2,048,405	42,104
Sodium sulfate (natural) .... do	619,752	11,024	640,829	11,271	636,843	10,710	699,706	12,729
Stone [6] .... thousand short tons	780,242	1,203,831	813,374	1,260,715	785,592	1,240,244	819,403	1,317,753
Sulfur:								
Frasch process mines .... thousand long tons	7,251	164,654	7,721	201,292	7,682	251,670	6,645	268,146
Other mines .... long tons	2,852	11	557	5	568	3	3,125	46
Talc, soapstone, and pyrophyllite .... short tons	862,875	6,343	895,045	6,479	902,512	6,871	958,262	6,656
Tripoli .... do	71,138	381	66,163	328	70,984	377	85,534	796
Vermiculite .... thousand short tons	249	4,460	262	4,954	255	4,974	290	5,684
Value of items that cannot be disclosed: Aplite, brucite, diatomite, graphite, iodine, kyanite, lithium minerals, magnesite, greensand marl, olivine, staurolite, wollastonite, and values indicated by footnote 5	XX	65,028	XX	69,911	XX	55,784	XX	79,809
Total nonmetals	XX	4,933,000	XX	5,176,000	XX	5,206,000	XX	5,452,000
Metals:								
Antimony ore and concentrate short tons, antimony content	845	(7)	927	(7)	892	(7)	856	(7)
Bauxite .... thousand long tons, dried equivalent	1,654	$18,682	1,796	$20,095	1,654	$19,079	1,665	$28,752
Beryllium concentrate .... short tons, gross weight	(7)	(7)	(7)	(7)	(7)	(7)	168	81
Copper (recoverable content of ores, etc.) .... short tons	1,351,734	957,028	1,429,152	1,033,850	954,064	729,401	1,204,621	1,008,195
Gold (recoverable content of ores, etc.) ..... troy ounces	1,705,190	59,682	1,803,420	63,119	1,584,187	55,447	1,478,292	[8] 58,088
Iron ore, usable (excluding byproduct iron sinter) thousand long tons, gross weight	84,079	801,388	90,040	854,134	82,415	817,511	81,984	886,433
Lead (recoverable content of ores, etc.) .. short tons	301,147	93,959	327,368	98,964	316,931	88,741	359,156	94,903
Manganese ore (35 percent or more Mn) short tons, gross weight	29,258	(7)	14,406	(7)	12,585	(7)	11,878	(7)
Manganiferous ore (5 to 35 percent Mn) .... do	332,763	(7)	324,926	(7)	289,160	(7)	244,590	(7)
Mercury .... 76-pound flasks	19,582	11,176	22,008	9,722	23,784	11,639	28,874	15,464
Molybdenum (content of concentrate) . thousand pounds	77,310	120,801	91,670	144,827	81,596	133,604	98,245	151,000
Nickel (content of ore and concentrate) ...... short tons	16,188	(7)	15,036	(7)	15,287	(7)	17,294	(7)
Silver (recoverable content of ores, etc.) thousand troy ounces	39,806	51,469	43,669	56,463	[r] 32,345	[r] 50,135	32,729	70,191
Tin (content of concentrate) .... long tons	47	126	97	265	(7)	(7)	(7)	(7)
Titanium concentrate, ilmenite short tons, gross weight	948,832	18,058	868,436	17,608	882,414	18,519	960,118	19,484
Tungsten ore and concentrate short tons, 60 percent WO₃ basis	7,949	13,028	8,912	17,620	9,088	20,895	10,704	25,197
Uranium (recoverable content U₃O₈) ... thousand pounds	19,727	157,828	19,037	152,281	20,655	165,289	24,139	182,698
Vanadium (recoverable in ore and concentrate) short tons	5,226	18,284	5,166	22,210	4,968	21,881	6,483	28,143
Zinc (recoverable content of ores, etc.) .... do	611,153	178,284	572,558	166,044	549,413	151,562	529,446	142,950

See footnote at end of table.

Table 2.—Mineral production[1] in the United States—Continued

Mineral	1965		1966		1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Value of items that cannot be disclosed: Cobalt, columbium-tantalum concentrate (1967), magnesium chloride for magnesium metal, manganiferous residuum, platinum-group metals (crude), rare-earth metal concentrates, titanium concentrate (rutile), zirconium concentrate, and values indicated by footnote 7	XX	$44,804	XX	$46,615	XX	$50,190	XX	$51,030
Total metals	XX	2,544,000	XX	2,708,000	XX	2,888,000	XX	2,708,000
Grand total mineral production	XX	21,524,000	XX	[r] 22,968,000	XX	[r] 23,784,000	XX	24,974,000

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[r] Revised. NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Includes small quantity of anthracite mined in States other than Pennsylvania.

[3] Final figure; supersedes figure given in commodity section.

[4] Grindstones, pulpstones, millstones (weight not recorded), grinding pebbles, sharpening stones, and tube-mill liners.

[5] Figure withheld to avoid disclosing individual company confidentila data; value included with "Nonmetal items that cannot be disclosed."

[6] Excludes abrasive stone, bituminous limestone, bituminous sandstone, and ground soapstone, all included elsewhere in table.

[7] Figure withheld to avoid disclosing individual company confidential data; value included with "Metal items that cannot be disclosed."

[8] Based on average U.S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968, and the New York selling price for the remainder of the year.

Table 3.—Minerals produced in the United States and principal producing States in 1968

Mineral	Principal producing States in order of quantity	Other producing States
Antimony	Idaho, Alaska.	
Aplite	Va.	
Asbestos	Calif., Vt., Ariz., N.C.	
Asphalt	Tex., Utah, Ala., Ky	Mo.
Barite	Mo., Nev., Ark., Ga	Alaska, Calif., N.C., Tenn.
Bauxite	Ark., Ala., Ga.	
Beryllium	Colo., S. Dak., N. Mex.	
Boron	Calif.	
Bromine	Mich., Tex., Ark., Calif.	
Brucite	Nev.	
Calcium-magnesium chloride	Mich., Calif.	
Carbon dioxide	N. Mex., Colo., Calif., Utah.	
Cement	Calif., Pa., Tex., Mich	Ala., Ariz., Ark., Colo., Fla., Ga., Hawaii, Idaho., Ill., Ind., Iowa, Kans., Ky., La., Maine, Md., Minn., Miss., Mo., Mont., Nebr., Nev., N. Mex., N.Y., N.C., Ohio, Okla., Oreg., S.C., S. Dak., Tenn., Utah, Va., Wash., W. Va., Wis., Wyo.
Clays	Ga., Ohio, Tex., N.C	All other States except Alaska, R.I.
Coal	W. Va., Ky., Pa., Ill	Ala., Alaska, Ark., Colo., Ind., Iowa, Kans., Md., Mo., Mont., N. Mex., N. Dak., Ohio, Okla., Tenn., Utah, Va., Wash., Wyo.
Cobalt	Pa.	
Columbium-tantalum	S. Dak.	
Copper	Ariz., Utah, N. Mex., Nev	Alaska, Calif., Colo., Idaho, Maine, Mich., Mo., Mont., Okla., Oreg., Pa., Tenn., Wash.
Diatomite	Calif., Nev., Wash., Ariz	Oreg.
Emery	N.Y.	
Feldspar	N.C., Calif., Conn., Ga	Ariz., Colo., Maine, N.H., N. Mex., S.C., S. Dak., Va., Wyo.
Fluorspar	Ill., Ky., Mont., Colo	Ariz., Nev., N. Mex., Utah.
Garnet, abrasive	N.Y., Idaho.	
Gold	S. Dak., Utah, Nev., Ariz	Alaska, Calif., Colo., Idaho, Mont., N. Mex., Oreg., Pa., Tenn., Wash.
Graphite	Tex.	
Gypsum	Mich., Calif., Iowa, Tex	Ariz., Ark., Colo., Idaho, Ind., Kans., La., Mont., Nev., N. Mex., N.Y., Ohio, Okla., S. Dak., Utah, Va., Wash., Wyo.
Helium	Kans., Tex., Okla., Ariz	N. Mex.
Iodine	Mich.	
Iron ore	Minn., Mich., Calif., Wyo	Ala., Ariz., Colo., Ga., Idaho, Miss., Mo., Mont., Nev., N.J., N. Mex., N.Y., Pa., Tex., Utah, Va.
Kyanite	Va., Ga., S.C., Fla.	
Lead	Mo., Idaho, Utah, Colo	Alaska, Ariz., Calif., Ill., Kans., Ky., Mont., Nev., N. Mex., N.Y., Okla., Va., Wash., Wis.
Lime	Ohio, Pa., Mich., Mo	Ala., Ariz., Ark., Calif., Colo., Conn., Fla., Hawaii, Idaho, Ill., Ind., Iowa, Kans., La., Md., Mass., Minn., Miss., Mont., Nebr., Nev., N.J., N. Mex., N.Y., N. Dak., Okla., Oreg., S. Dak., Tenn., Tex., Utah, Vt., Va., Wash., W. Va., Wis., Wyo.
Lithium	N.C., Nev., Calif., S. Dak.	
Magnesite	Nev., Wash.	
Magnesium chloride	Tex.	
Magnesium compounds	Mich., Tex., Calif., N.J	Fla., Miss., Utah.
Manganese ore	N. Mex., Mont.	
Manganiferous ore	Minn., N. Mex., Mont.	
Manganiferous residuum	N.J.	
Marl, greensand	N.J., Md.	
Mercury	Calif., Nev., Idaho, Oreg	Alaska, Ariz., Tex., Wash.
Mica:		
Scrap	N.C., Ala., Ga., S.C	Ariz., Calif., Conn., N. Mex., Pa., S. Dak.
Sheet	N.C.	
Molybdenum	Colo., Ariz., Utah., N. Mex	Calif., Nev.
Natural gas	Tex., La., Okla., N. Mex	Ala., Alaska., Ariz., Ark., Calif., Colo., Fla., Ill., Ind., Kans., Ky., Md., Mich., Miss., Mo., Mont., Nebr., N.Y., N. Dak., Ohio., Pa., Tenn., Utah, Va., W. Va., Wyo.

Table 3.—Minerals produced in the United States and principal producing States in 1968—Continued

Mineral	Principal producing States in order of quantity	Other producing States
Natural gas liquids	Tex., La., Okla., N. Mex	Ark., Calif., Colo., Fla., Ill., Kans., Ky., Mich., Miss., Mont., Nebr., N. Dak., Pa., Utah., W. Va., Wyo.
Nickel	Oreg.	
Olivine	Wash., N.C.	
Peat	Mich., Ill., N.J., Ind	Calif., Colo., Fla., Ga., Idaho, Iowa, Maine, Md., Mass., N. Mex., N.Y., N. Dak., Ohio, Oreg., Pa., S.C., Vt., Wash., Wis.
Perlite	N. Mex., Ariz., Nev., Calif	Colo., Idaho.
Petroleum	Tex., La., Calif., Okla	Ala., Alaska, Ariz., Ark., Colo., Fla., Ill., Ind., Kans., Ky., Mich., Miss., Mo., Mont., Nebr., Nev., N. Mex., N.Y., N. Dak., Ohio., Pa., S. Dak., Tenn., Utah, Va., W. Va., Wyo.
Phosphate rock	Fla., Idaho, Tenn., N.C	Calif., Mont., Utah, Wyo.
Platinum-group metals	Alaska, Calif.	
Potassium salts	N. Mex., Utah, Calif., Mich	Md.
Pumice	Ariz., Calif., Oreg., Hawaii	Colo., Idaho, Kans., Mont., Nebr., Nev., N. Mex., Okla., Tex., Utah, Wash.
Pyrites	Tenn., Pa., Colo., Ariz	S.C., Utah.
Rare-earth metals	Calif., Ga., Fla., Colo.	
Salt	La., Tex., Ohio, N.Y	Ala., Calif., Colo., Hawaii, Kans., Mich., Nev., N. Mex., N. Dak., Okla., Utah, Va., W. Va.
Sand and gravel	Calif., Mich., Ohio, Ill	All other States.
Silver	Idaho, Utah, Ariz., Mont	Alaska, Calif., Colo., Maine, Mich., Mo., Nev., N. Mex., N.Y., Okla., Oreg., Pa., S. Dak., Tenn., Wash.
Sodium carbonate	Wyo., Calif.	
Sodium sulfate	Calif., Tex., Wyo.	
Staurolite	Fla.	
Stone	Pa., Ill., Tex., Ohio	All other States.
Sulfur (Frasch)	La., Tex.	
Sulfur, ore	Calif.	
Talc soapstone, and pyrophyllite.	N.Y., Calif., Vt., Tex	Ala., Ark., Ga., Md., Mont., Nev., N.C., Oreg., Pa., Va., Wash.
Tin	Colo., Alaska.	
Titanium	N.Y., Fla., N.J., Ga	Va.
Tripoli	Ill., Okla., Ark., Pa.	
Tungsten	Calif., Colo., Mont., Nev	Ariz., Idaho, Utah.
Uranium	N. Mex., Wyo., Colo., Utah	Ariz., N. Dak., S. Dak., Tex.
Vanadium	Colo., Ark., Idaho, Utah	Ariz., N. Mex.
Vermiculite	Mont., S.C., Tex., Ariz.	
Wollastonite	N.Y., Calif.	
Zinc	Tenn., N.Y., Idaho, Colo	Ariz., Calif., Ill., Kans., Ky., Maine, Mo., Mont., Nev., N.J., N. Mex., Okla., Pa., Utah, Va., Wash., Wis.
Zirconium	Fla., Ga.	

Table 4.—Value of mineral production in the United States, and principal minerals produced in 1968

(Thousands)

State	Value	Rank	Percent of U.S. total	Principal minerals in order of value
Alabama	$259,621	22	1.04	Coal, cement, stone, petroleum.
Alaska	221,717	25	.89	Petroleum, sand and gravel, coal, natural gas.
Arizona	617,541	10	2.47	Copper, molybdenum, cement, sand and gravel.
Arkansas	198,723	28	.80	Petroleum, natural gas, bauxite, stone.
California	1,808,147	3	7.24	Petroleum, natural gas, sand and gravel, cement.
Colorado	359.458	17	1.44	Molybdenum, petroleum, coal, sand and gravel.
Connecticut	23,876	45	.10	Stone, sand and gravel, feldspar, lime.
Delaware	1,996	50	.01	Sand and gravel, stone, clays, gem stones.
Florida	304,623	18	1.22	Phosphate rock, stone, cement, clays.
Georgia	173.090	29	.69	Clays, stone, cement, sand and gravel.
Hawaii	23,225	46	.09	Stone, cement, sand and gravel, pumice.
Idaho	114,253	32	.46	Silver, phosphate rock, zinc, lead.
Illinois	647,543	8	2.59	Coal, petroleum, stone, sand and gravel.
Indiana	235,386	23	.94	Coal, cement, stone, petroleum.
Iowa	117,297	31	.47	Cement, stone, sand and gravel, gypsum.
Kansas	568,701	12	2.28	Petroleum, natural gas, helium, natural gas liquids.
Kentucky	534,863	15	2.14	Coal, stone, petroleum, natural gas.
Louisiana	4,321,010	2	17.30	Petroleum, natural gas, natural gas liquids, sulfur.
Maine	17,810	47	.07	Cement, sand and gravel, stone, zinc.
Maryland	71,844	38	.29	Stone, cement, sand and gravel, coal.
Massachusetts	43,340	43	.17	Sand and gravel, stone, lime, clays.
Michigan	627,075	9	2.51	Iron ore, cement, copper, sand and gravel.
Minnesota	567,427	13	2.27	Iron ore, sand and gravel, stone, cement.
Mississippi	220,955	26	.88	Petroleum, natural gas, sand and gravel, clays.
Missouri	275,955	21	1.10	Cement, stone, lead, iron ore.
Montana	228,131	24	.91	Petroleum, copper, sand and gravel, cement.
Nebraska	74,837	37	.30	Petroleum, cement, sand and gravel, stone.
Nevada	120,041	30	.48	Copper, gold, sand and gravel, diatomite.
New Hampshire	9,166	48	.04	Sand and gravel, stone, clays, feldspar.
New Jersey	77,466	36	.31	Sand and gravel, stone, zinc, magnesium compounds.
New Mexico	893,775	7	3.58	Petroleum, natural gas, uranium, copper.
New York	299,636	19	1.20	Cement, stone, sand and gravel, salt.
North Carolina	82,819	34	.33	Stone, sand and gravel, phosphate rock, cement.
North Dakota	98,036	33	.39	Petroleum, sand and gravel, coal, natural gas.
Ohio	536,898	14	2.15	Coal, stone, sand and gravel, cement.
Oklahoma	1,016,832	4	4.07	Petroleum, natural gas, natural gas liquids, stone.
Oregon	64,449	40	.26	Sand and gravel, stone, cement, nickel.
Pennsylvania	904,044	6	3.62	Coal, cement, stone, sand and gravel.
Rhode Island	4,222	49	.02	Sand and gravel, stone, gem stones.
South Carolina	51,858	42	.21	Cement, stone, clays, sand and gravel.
South Dakota	54,086	41	.22	Gold, sand and gravel, stone, cement.
Tennessee	201,334	27	.81	Stone, zinc, cement, coal.
Texas	5,505,831	1	22.05	Petroleum, natural gas, natural gas liquids, cement.
Utah	423,951	16	1.70	Copper, petroleum, coal, molybdenum.
Vermont	28,715	44	.11	Stone, asbestos, sand and gravel, talc.
Virginia	295,663	20	1.18	Coal, stone, cement, sand and gravel.
Washington	81,385	35	.33	Sand and gravel, cement, stone, zinc.
West Virginia	917,708	5	3.67	Coal, natural gas, stone, natural gas liquids.
Wisconsin	71,695	39	.29	Sand and gravel, stone, zinc, cement.
Wyoming	576,190	11	2.31	Petroleum, uranium, natural gas, sodium salts.
Total	24,974,244	--	100.00	Petroleum, natural gas, coal, stone.

Table 5.—Mineral production[1] in the United States, by States

Mineral	1965		1966		1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
ALABAMA								
Cement:[2]								
Portland.....thousand 376-pound barrels..	13,765	$42,604	16,394	$49,537	15,364	$46,510	15,514	$48,147
Masonry.....thousand 280-pound barrels..	2,598	7,853	2,570	7,613	2,377	6,938	2,523	7,309
Clays.....thousand short tons..	[3] 2,220	[3] 4,888	2,448	5,142	2,724	7,422	2,793	6,995
Coal (bituminous).....do....	14,832	106,249	14,219	100,112	15,486	110,696	16,440	115,815
Iron ore (usable).....thousand long tons, gross weight..	1,495	8,241	1,508	8,702	1,472	8,286	1,151	6,730
Lime.....thousand short tons..	653	7,905	699	8,442	624	7,719	778	8,933
Natural gas.....million cubic feet..	203	26	252	32	248	31	280	30
Petroleum (crude).....thousand 42-gallon barrels..	8,064	21,047	8,080	20,878	7,848	19,500	7,635	20,385
Sand and gravel.....thousand short tons..	6,422	7,195	7,082	7,953	7,229	7,969	8,140	9,130
Stone.....do....	[4] 17,987	[4] 30,810	[4] 20,744	[4] 36,839	18,371	33,846	20,643	33,847
Value of items that cannot be disclosed: Native asphalt, bauxite, slag cement, clays (kaolin 1965, bentonite 1965), scrap mica, salt, stone (dimension limestone 1965–66, dimension marble 1965–66, shell 1965, crushed sandstone 1965–66), talc, and tripoli (1965).....	XX	9,446	XX	4,528	XX	2,974	XX	2,300
Total.....	XX	246,264	XX	249,778	XX	251,891	XX	259,621
ALASKA								
Antimony ore and concentrate.....short tons, antimony content..	1	$1	8	W	10	W	3	W
Barite.....thousand short tons..	---------	---------	W	W	W	W	91	W
Coal (bituminous).....do....	893	6,095	927	$6,953	925	$7,296	750	$4,502
Copper (recoverable content of ores, etc.).....short tons..	82	28	W	W	W	W	W	W
Gold (recoverable content of ores, etc.).....troy ounces..	42,249	1,479	27,325	956	22,948	803	21,262	[5] 835
Lead (recoverable content of ores, etc.).....short tons..	9	3	14	4	---------	---------	W	W
Natural gas.....million cubic feet..	7,255	1,799	11,267	2,794	14,438	3,610	17,843	4,388
Peat.....short tons..	1,967	16	W	W	1,528	12	---------	---------
Petroleum (crude).....thousand 42-gallon barrels..	11,128	34,073	14,358	44,007	29,126	91,164	66,204	186,695
Sand and gravel.....thousand short tons..	30,266	34,467	17,457	21,793	22,370	26,248	18,018	20,366
Silver (recoverable content of ores, etc.).....thousand troy ounces..	8	10	7	9	6	9	4	8
Value of items that cannot be disclosed: Gem stones, mercury, platinum-group metals, stone, tin, uranium ore (1965) and values indicated by symbol W.....	XX	5,512	XX	6,167	XX	4,924	XX	4,923
Total.....	XX	83,478	XX	82,683	XX	134,066	XX	221,717
ARIZONA								
Asbestos.....short tons..	3,469	$441	W	W	W	W	W	W
Clays.....thousand short tons..	[3] 129	[3] 164	[3] 89	[3] $121	[3] 67	[3] $87	77	$347
Coal (bituminous).....do....	---------	---------	---------	---------	1	5	---------	---------
Copper (recoverable content of ores, etc.).....short tons..	708,377	497,991	789,569	585,004	501,741	383,591	627,961	525,566
Diatomite.....do....	295	8	1,358	86	W	W	W	W

Fluorspar ---- do ----	--------	--------	--------	--------	10,000	280	--------	--------
Gem stones ----	NA	120	NA	120	NA	150	NA	149
Gold (recoverable content of ores, etc.) ---- troy ounces ----	150,431	5,265	142,528	4,988	80,844	2,830	95,999	[5] 3,769
Gypsum ---- thousand short tons ----	103	540	75	394	W	W	W	W
Helium, grade A ---- thousand cubic feet ----	58,000	2,030	63,500	2,222	73,800	2,066	64,800	1,600
Iron ore (usable) ---- thousand long tons, gross weight ----	8	51	W	W	W	W	16	124
Lead (recoverable content of ores, etc.) ---- short tons ----	5,913	1,845	5,211	1,575	4,771	1,336	1,704	450
Lime ---- thousand short tons ----	204	3,543	218	3,721	186	3,142	260	4,561
Mercury ---- 76-pound flasks ----	158	90	363	160	W	W	192	103
Molybdenum (content of concentrate) ---- thousand pounds ----	9,399	15,880	10,161	17,812	9,261	15,385	12,127	19,207
Natural gas ---- million cubic feet ----	3,106	376	3,161	436	1,255	193	881	142
Petroleum (crude) ---- thousand 42-gallon barrels ----	97	W	132	370	2,924	8,188	3,370	9,606
Pumice ---- thousand short tons ----	1,161	1,515	1,103	1,674	1,064	904	1,033	974
Sand and gravel ---- do ----	14,918	16,621	18,730	20,448	[r] 18,463	[r] 18,409	13,981	14,423
Silver (recoverable content of ores, etc.) ---- thousand troy ounces ----	6,095	7,881	6,339	8,196	4,588	7,112	4,958	10,633
Stone ---- thousand short tons ----	2,474	4,171	2,271	4,091	1,910	3,491	3,293	6,239
Tungsten ore and concentrate ---- short tons, 60-percent WO_3 basis ----	3	5	2	5	W	W	1	3
Uranium (recoverable content U_3O_8) ---- thousand pounds ----	W	W	437	3,492	83	666	295	1,923
Vanadium (recoverable in ore and concentrate) ---- short tons ----	W	381	W	453	W	W	W	W
Zinc (recoverable content of ores, etc.) ---- do ----	21,757	6,353	15,985	4,636	14,330	3,967	5,441	1,469
Value of items that cannot be disclosed: Cement, clays (bentonite 1965–67), feldspar, scrap mica, perlite, pyrites, vermiculite (1967–68), and values indicated by symbol W ----	XX	17,847	XX	12,125	XX	13,503	XX	16,253
Total ----	XX	583,118	XX	622,079	XX	[r] 465,255	XX	617,541

ARKANSAS

Barite ---- thousand short tons ----	249	$2,379	233	$2,266	229	$2,266	166	$3,839
Bauxite ---- thousand long tons, dried equivalent ----	1,593	17,974	1,718	19,439	1,571	18,269	1,582	23,058
Bromine and bromine in compounds ---- thousand pounds ----	32,254	7,171	42,307	10,467	64,450	14,885	95,499	20,790
Clays ---- thousand short tons ----	866	1,890	[3] 775	[3] 776	941	1,740	919	2,134
Coal (bituminous) ---- do ----	226	1,643	236	1,640	189	1,427	211	1,576
Gem stones ----	NA	31	NA	35	NA	35	NA	30
Lime ---- thousand short tons ----	192	2,776	207	3,004	187	2,723	206	3,058
Natural gas ---- million cubic feet ----	82,831	12,922	105,174	16,407	116,522	17,828	156,627	24,456
Natural gas liquids:								
Natural gasoline and cycle products ---- thousand 42-gallon barrels ----	662	1,578	763	1,923	656	1,780	753	2,192
LP gases ---- do ----	1,661	3,139	1,540	3,233	1,279	3,009	1,435	2,899
Petroleum (crude) ---- do ----	25,930	68,974	23,824	63,372	21,075	56,902	19,464	53,137
Sand and gravel ---- thousand short tons ----	12,806	15,836	16,056	21,038	14,239	15,531	12,997	14,643
Stone ---- do ----	21,241	26,778	19,109	24,588	17,454	23,236	16,322	22,256
Value of items that cannot be disclosed: Abrasive stones, cement, clays (kaolin and fire clay 1966), gypsum, iron ore (1965), mercury (1966–67) phosphate rock (1965–66), soapstone, tripoli, vanadium (1968), and values indicated by symbol W ----	XX	16,019	XX	21,939	XX	19,822	XX	24,655
Total ----	XX	179,110	XX	190,127	XX	179,453	XX	198,723

See footnotes at end of table.

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1965		1966		1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
CALIFORNIA								
Antimony ore and concentrate short tons, antimony content	---------	---------	1	(6)	---------	---------	---------	---------
Asbestos short tons	74,587	$6,177	81,671	$6,945	77,091	$6,726	75,592	$6,139
Barite thousand short tons	4	21	15	104	10	71	W	W
Boron minerals do	807	64,180	866	68,209	955	74,130	1,026	79,827
Cement thousand 376-pound barrels	45,352	144,852	45,387	146,302	42,034	137,961	47,595	151,961
Clays thousand short tons	3,207	7,226	2,984	6,708	2,609	6,037	2,755	6,630
Copper (recoverable content of ores, etc.) short tons	1,165	825	1,078	780	788	602	1,182	989
Feldspar long tons	95,975	W	100,915	W	94,769	W	W	W
Gem stones	NA	200	NA	200	NA	200	NA	200
Gold (recoverable content of ores, etc.) troy ounces	62,885	2,201	64,764	2,267	40,570	1,420	15,682	[5] 616
Gypsum thousand short tons	1,611	3,881	1,207	3,064	1,241	3,150	1,360	3,603
Lead (recoverable content of ores, etc.) short tons	1,810	565	1,976	597	1,785	486	4,001	1,057
Lime thousand short tons	602	11,073	552	8,764	539	8,696	568	9,301
Magnesium compounds from sea water and bitterns (partly estimated) short tons, MgO equivalent	95,652	7,955	87,816	7,413	76,592	6,882	81,622	7,229
Mercury 76-pound flasks	13,404	7,650	16,070	7,100	16,385	8,018	21,417	11,470
Natural gas million cubic feet	660,384	204,059	r 689,607	r 204,059	681,080	202,290	714,893	221,077
Natural gas liquids:								
Natural gasoline and cycle products thousand 42-gallon barrels	15,614	49,850	15,110	r 48,867	14,605	r 46,620	18,403	42,968
LP gases do	8,073	15,467	8,409	17,304	8,730	19,065	8,589	18,749
Peat short tons	30,905	434	29,235	384	30,014	396	W	W
Perlite do	W	W	W	W	W	W	8,806	80
Petroleum (crude) thousand 42-gallon barrels	316,428	758,099	345,295	812,834	359,219	829,188	375,496	883,644
Pumice thousand short tons	676	1,744	580	1,763	866	1,357	776	1,312
Salt do	1,638	W	1,693	W	1,732	W	1,901	W
Sand and gravel do	118,310	136,227	120,692	139,157	116,125	139,212	124,655	153,360
Silver (recoverable content of ores, etc.) thousand troy ounces	197	254	190	246	145	224	598	1,282
Stone thousand short tons	42,575	59,668	43,051	61,336	37,186	55,263	36,125	52,671
Sulfur ore long tons	360	2	557	5	568	3	3,125	46
Talc, soapstone, and pyrophyllite short tons	141,074	1,725	138,340	1,847	143,466	1,945	165,396	2,075
Tin (content of concentrate) long tons	W	W	13	21	W	W	---------	---------
Zinc (recoverable content of ores, etc.) short tons	225	66	335	97	441	122	3,525	952
Value of items that cannot be disclosed: Bromine, calcite (optical grade, 1965–66), calcium-magnesium chloride, carbon dioxide, coal (lignite), diatomite, iodine (1965–66), iron ore, lithium minerals, scrap mica, molybdenum, phosphate rock (1968), platinum group metals (crude), potassium salts, rare-earth metal concentrates, sodium carbonates and sulfates, tungsten concentrate, uranium (1965–66), wollastonite, and values indicated by symbol W	XX	117,904	XX	141,449	XX	143,722	XX	150,914
Total	XX	1,597,305	XX	r 1,687,822	XX	r 1,693,781	XX	1,808,147

COLORADO

Carbon dioxide, natural......thousand cubic feet..	155,668	$26	147,292	$25	182,701	$31	200,657	$34
Clays......thousand short tons..	631	1,446	599	1,315	596	1,274	616	1,222
Coal (bituminous)......do....	4,790	24,431	5,222	26,075	5,439	25,920	5,558	26,785
Copper (recoverable content of ores, etc.)......short tons..	3,828	2,710	4,237	3,065	3,993	3,053	3,451	2,888
Feldspar......long tons..	521	3	891	6	300	2	W	W
Gem stones......	NA	80	NA	80	NA	118	NA	121
Gold (recoverable content of ores, etc.)......troy ounces..	37,228	1,303	31,915	1,117	21,181	741	22,638	[5] 889
Gypsum......thousand short tons..	100	379	75	269	77	265	98	354
Iron ore (usable)......thousand long tons, gross weight..	114	787	164	1,133	W	W	W	W
Lead (recoverable content of ores, etc.)......short tons..	22,495	7,018	23,082	6,978	21,923	6,138	19,778	5,226
Lime......thousand short tons..	118	2,074	126	2,327	118	2,028	125	2,375
Manganiferous ore (5 to 35 percent Mn)......short tons, gross weight..	---------	---------	---------	---------	321	3	---------	---------
Molybdenum (content of concentrate)......thousand pounds..	[7] 50,715	[7] 78,609	57,289	88,851	52,040	84,728	61,684	100,296
Natural gas......million cubic feet..	126,381	16,303	136,667	17,767	116,857	15,542	121,424	16,392
Natural gas liquids:								
Natural gasoline......thousand 42-gallon barrels..	1,290	3,034	1,415	3,565	1,234	3,215	1,289	3,248
LP gases......do....	2,176	3,930	1,747	3,596	1,708	3,649	1,987	3,338
Peat......short tons..	31,179	236	37,111	278	21,988	204	28,457	250
Petroleum (crude)......thousand 42-gallon barrels..	33,511	96,512	33,492	97,462	33,905	99,003	31,937	94,215
Pumice......thousand short tons..	56	134	46	104	18	105	28	234
Pyrites......thousand long tons..	30	90	W	W	W	W	23	97
Sand and gravel......thousand short tons..	20,810	22,041	22,245	23,485	21,810	22,904	23,131	26,608
Silver (recoverable content of ores, etc.)......thousand troy ounces..	2,051	2,652	2,085	2,697	1,818	2,817	1,646	3,531
Stone......thousand short tons..	4,789	8,638	7,031	11,331	2,992	5,485	2,471	5,201
Tin (content of concentrate)......long tons..	32	76	44	99	31	59	33	64
Tungsten concentrate......short tons, 60 percent WO_3 basis..	1,176	1,985	1,494	3,626	1,276	3,039	1,893	4,413
Uranium (recoverable content U_3O_8)......thousand pounds..	W	W	2,651	21,205	2,537	20,299	2,706	20,009
Vanadium (recoverable in ore and concentrate)......short tons..	4,017	14,056	3,697	15,888	3,317	14,260	3,492	12,468
Zinc (recoverable content of ores, etc.)......do....	53,870	15,730	54,822	15,898	52,442	14,519	50,258	13,570
Value of items that cannot be disclosed: Beryllium concentrate, cement, fluorspar, scrap mica (1967), perlite, rare-earth metal concentrates (1966–68), salt, and values indicated by symbol W......	XX	35,867	XX	14,699	XX	16,834	XX	15,630
Total......	XX	340,150	XX	362,941	XX	346,235	XX	359,458

CONNECTICUT

Clays......thousand short tons..	237	$322	192	$296	191	$334	195	$325
Gem stones......	NA	8	NA	8	NA	8	NA	8
Sand and gravel......thousand short tons..	9,940	9,106	9,561	8,963	8,320	8,710	8,752	9,321
Stone......do....	5,871	10,444	5,618	10,482	5,097	10,141	6,383	12,729
Value of items that cannot be disclosed: Feldspar, lime, scrap mica, and peat (1965–66)......	XX	1,354	XX	1,597	XX	1,426	XX	1,493
Total......	XX	21,234	XX	21,346	XX	20,619	XX	23,876

See footnotes at end of table.

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1965		1966		1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
DELAWARE								
Clays thousand short tons	11	$11	11	$11	11	$11	12	$12
Gem stones	NA	1	NA	1	NA	1	NA	1
Sand and gravel thousand short tons	1,545	1,441	1,610	1,443	1,966	1,846	1,596	1,488
Stone do	180	450	210	525	210	525	200	500
Total	XX	1,903	XX	1,980	XX	2,383	XX	1,996
FLORIDA								
Clays thousand short tons	651	$9,752	762	$11,408	756	$11,574	808	$11,699
Lime do	101	1,558	185	1,966	155	2,425	125	2,059
Natural gas million cubic feet	107	14	212	80	123	18	108	16
Peat short tons	19,253	109	11,500	91	22,180	155	41,218	277
Petroleum (crude) thousand 42-gallon barrels	1,464	W	1,799	W	1,568	W	1,474	W
Phosphate rock thousand short tons	21,563	141,258	W	W	W	W	W	W
Sand and gravel do	7,298	6,377	7,408	6,417	6,912	6,479	7,765	7,967
Stone do	35,730	41,148	35,023	38,167	[4] 33,971	[4] 38,723	[4] 36,692	[4] 46,563
Value of items that cannot be disclosed: Cement, kyanite (1968), magnesium compounds, natural gas liquids, rare-earth metal concentrates, staurolite, stone (dimension limestone 1967–68), titanium concentrate, zirconium concentrate, and values indicated by symbol W	XX	49,104	XX	237,368	XX	250,423	XX	236,042
Total	XX	249,320	XX	295,447	XX	309,797	XX	304,628
GEORGIA								
Barite thousand short tons	W	W	W	W	W	W	140	$2,874
Clays do	4,607	$68,158	5,128	$73,685	4,953	$77,314	5,111	88,682
Iron ore (usable) thousand long tons, gross weight	430	2,208	447	2,200	267	1,450	192	1,119
Mica:								
Scrap short tons	18,065	W	16,608	380	17,158	291	W	W
Sheet pounds	2,798	(6)	--------	--------	--------	--------	--------	--------
Sand and gravel thousand short tons	3,675	3,588	3,915	4,185	3,787	4,206	3,808	4,314
Stone do	23,421	48,265	24,690	48,198	23,418	49,958	26,903	56,177
Talc short tons	44,800	318	41,000	255	46,150	292	45,600	288
Value of items that cannot be disclosed: Bauxite, cement, feldspar, kyanite, peat, rare-earth metal concentrates (1966–68), titanium concentrate, zirconium concentrate, and values indicated by symbol W	XX	17,688	XX	19,699	XX	19,952	XX	19,686
Total	XX	185,220	XX	148,597	XX	158,458	XX	173,090

HAWAII								
Cement thousand 376-pound barrels	1,564	$8,297	1,749	$9,046	1,395	$7,360	1,841	$9,254
Clays thousand short tons	W	W	W	W	W	W	3	4
Lime do	9	305	10	320	8	265	8	268
Pumice do	380	624	374	716	290	562	408	724
Sand and gravel do	751	2,237	511	1,591	469	1,467	546	1,653
Stone do	5,172	9,353	5,079	9,482	4,100	7,207	5,211	11,273
Value of items that cannot be disclosed: Other nonmetals and values indicated by symbol W	XX	19	XX	98	XX	75	XX	49
Total	XX	20,835	XX	21,253	XX	16,936	XX	23,225
IDAHO								
Antimony ore and concentrate short tons, antimony content	818	W	834	W	823	W	853	W
Clays [3] thousand short tons	47	$33	23	$22	19	$16	12	$14
Cobalt thousand pounds	-----	-----	1	6	-----	-----	-----	-----
Copper (recoverable content of ores, etc.) short tons	5,140	3,639	4,961	3,589	4,210	3,219	3,525	2,950
Gem stones	NA	150	NA	180	NA	180	NA	200
Gold (recoverable content of ores, etc.) troy ounces	5,078	178	5,056	177	4,838	169	3,227	[5] 127
Gypsum thousand short tons	-----	-----	-----	-----	-----	-----	3	13
Iron ore (usable) thousand long tons, gross weight	9	84	11	97	W	W	W	W
Lead (recoverable content of ores, etc.) short tons	66,606	20,781	72,334	21,867	61,387	17,188	54,790	14,478
Mercury 76-pound flasks	1,119	639	1,134	501	898	439	W	W
Peat short tons	W	W	W	W	2,040	16	W	W
Phosphate rock thousand short tons	W	W	W	W	W	W	3,879	22,721
Pumice do	46	79	55	107	W	W	135	259
Sand and gravel do	12,151	13,198	7,544	6,672	11,246	11,490	8,224	9,133
Silver (recoverable content of ores, etc.) thousand troy ounces	18,457	23,865	19,777	25,571	17,033	26,402	15,959	34,225
Stone thousand short tons	1,831	3,440	2,694	5,415	1,986	4,883	2,195	5,209
Tungsten concentrate short tons, 60-percent WO$_3$ basis	-----	-----	2	1	68	175	W	W
Zinc (recoverable content of ores, etc.) short tons	58,034	16,946	60,997	17,689	56,528	15,650	57,248	15,457
Value of items that cannot be disclosed: Cement, clays, (fire clay, bentonite 1965–66, kaolin), abrasive garnet, lime, perlite, titanium concentrate (1965–66), vanadium, and values indicated by symbol W	XX	22,053	XX	32,991	XX	29,631	XX	9,467
Total	XX	105,085	XX	114,885	XX	109,408	XX	114,253
ILLINOIS								
Cement:								
Portland thousand 376-pound barrels	9,358	$30,622	9,203	$28,617	9,069	$30,186	9,872	$32,475
Masonry thousand 280-pound barrels	615	1,907	614	1,868	591	1,851	602	2,097
Clays [3] thousand short tons	2,169	4,601	1,894	3,996	1,881	3,799	2,327	4,813
Coal (bituminous) do	58,483	218,972	63,571	244,837	65,133	252,975	62,441	250,685
Fluorspar short tons	159,140	7,861	176,175	8,002	210,207	9,859	188,825	9,134

See footnotes at end of table.

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1965 Quantity	1965 Value (thousands)	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
ILLINOIS—Continued								
Lead (recoverable content of ores, etc.) short tons	3,005	$938	2,285	$691	2,384	$668	1,467	$388
Natural gas million cubic feet	7,396	865	7,230	860	5,144	602	4,380	552
Peat short tons	36,774	453	44,374	565	49,716	697	61,520	867
Petroleum (crude) thousand 42-gallon barrels	63,708	186,664	[r] 61,661	[r] 184,983	[8] 60,115	[8] 181,581	56,391	173,120
Sand and gravel thousand short tons	36,228	40,480	38,237	43,201	38,801	44,175	45,609	52,943
Stone do	47,066	61,294	46,157	60,961	48,458	66,757	55,858	80,188
Zinc (recoverable content of ores, etc.) short tons	18,314	5,348	15,192	4,406	20,416	5,652	18,182	4,909
Value of items that cannot be disclosed: Clay (fuller's earth), gem stones, lime, natural gas liquids, and tripoli	XX	33,020	XX	34,362	XX	37,999	XX	35,372
Total	XX	593,025	XX	[r] 617,349	XX	636,801	XX	647,543
INDIANA								
Abrasive stones short tons	5	$15	5	$15	5	$16	5	$16
Cement[2] thousand 376-pound barrels	14,925	48,797	15,305	49,826	15,924	53,123	14,774	48,096
Clays thousand short tons	1,459	2,160	1,491	2,196	1,489	2,126	1,550	2,355
Coal (bituminous) do	15,565	59,927	17,326	67,857	18,772	73,419	18,486	71,680
Natural gas million cubic feet	239	56	215	51	198	46	234	55
Peat short tons	53,873	511	38,111	456	42,962	441	38,763	557
Petroleum (crude) thousand 42-gallon barrels	11,481	32,606	10,617	31,850	10,081	30,041	8,692	26,511
Sand and gravel thousand short tons	24,867	22,220	24,992	23,542	26,265	25,588	25,774	26,160
Stone do	24,574	42,124	24,323	42,474	26,977	46,725	26,307	46,790
Value of items that cannot be disclosed: Cement (masonry), gypsum, and lime (1966–68)	XX	10,299	XX	11,743	XX	13,396	XX	13,166
Total	XX	218,715	XX	230,010	XX	244,921	XX	235,386
IOWA								
Cement:								
Portland thousand 376-pound barrels	13,643	$46,273	14,058	$46,736	13,712	$45,394	13,900	$47,275
Masonry thousand 280-pound barrels	608	1,867	633	1,890	612	1,853	624	1,986
Clays thousand short tons	1,085	1,347	1,130	1,438	1,208	1,643	1,264	1,747
Coal (bituminous) do	1,043	3,694	1,025	3,783	883	3,227	876	3,289
Gypsum do	1,254	5,554	1,285	5,577	1,219	5,186	1,351	5,838
Sand and gravel do	18,205	17,152	19,644	18,213	17,734	16,564	16,332	15,192
Stone do	25,891	35,468	27,729	40,081	26,133	37,912	26,150	40,397
Value of items that cannot be disclosed: Gem stones, lime, and peat	XX	1,428	XX	1,595	XX	1,443	XX	1,573
Total	XX	112,783	XX	119,313	XX	113,222	XX	117,297

KANSAS								
Cement:[2]								
Portland, thousand 376-pound barrels	8,801	$26,972	8,979	$27,246	8,833	$25,545	9,680	$29,898
Masonry, thousand 280-pound barrels	404	1,178	395	1,151	350	1,000	383	1,177
Clays, thousand short tons	789	953	847	1,006	935	1,339	932	1,433
Coal (bituminous), do.	1,310	6,072	1,122	5,355	1,136	5,294	1,268	6,526
Helium: Crude, thousand cubic feet	2,551,026	29,518	2,624,200	30,951	2,719,700	32,554	2,749,700	33,600
Grade A, do.	19,763	904	75,500	1,885	225,000	5,364	291,700	7,300
Lead (recoverable content of ores, etc.), short tons	1,644	513	1,109	335	1,031	289	1,227	324
Natural gas, million cubic feet	793,379	105,519	847,495	114,412	871,971	116,844	835,555	115,307
Natural gas liquids:								
Natural gasoline, thousand 42-gallon barrels	3,654	7,791	4,168	9,399	4,623	10,703	4,824	10.977
LP gases, do.	13,986	22,322	15,813	25,902	15,835	31,923	15,748	25,827
Petroleum (crude), do.	104,733	305,820	103,738	306,027	99,200	297,600	94,505	285,405
Pumice, thousand short tons	W	W	W	W	W	W	11	10
Salt[9], do.	1,053	12,376	969	13,388	1,069	14,686	1,128	15,520
Sand and gravel, do.	12,544	8,473	11,627	8,374	12,066	8,650	12,427	10,559
Stone, do.	15,270	20,538	14,027	18,789	13,551	17,806	14,402	20,714
Zinc (recoverable content of ores, etc.), short tons	6,508	1,900	4,769	1,383	4,765	1,319	3,012	813
Value of items that cannot be disclosed: Natural cement, gypsum, lime (1968), salt (brine), and values indicated by symbol W	XX	2,642	XX	2,789	XX	3,152	XX	3,311
Total	XX	553,491	XX	568,392	XX	574,068	XX	568,701
KENTUCKY								
Clays[3], thousand short tons	1,059	$2,580	1,152	$2,277	1,195	$2,066	1,219	$1,952
Coal (bituminous), do.	85,766	324,523	93,156	363,440	100,294	396,883	101,156	395,039
Fluorspar, short tons	31,992	1,485	28,725	1,361	32,952	1,686	17,050	878
Lead (recoverable content of ores, etc.), do.	756	236	484	146	845	237	W	W
Natural gas, million cubic feet	78,976	18,638	76,536	18,139	89,168	21,400	89,024	22,256
Petroleum (crude), thousand 42-gallon barrels	19,386	55,638	18,066	51,488	15,535	45,052	14,036	41,125
Sand and gravel, thousand short tons	6,742	6,332	8,064	7,524	7,981	7,859	7,478	8,081
Silver (recoverable content of ores, etc.), thousand troy ounces	2	2	1	1	1	1	---------	---------
Stone, thousand short tons	26,029	34,533	22,667	31,179	24,812	35,481	30,105	43,266
Zinc (recoverable content of ores, etc.), short tons	5,654	1,651	6,586	1,910	6,317	1,749	W	W
Value of items that cannot be disclosed: Native asphalt (1966–68), cement, ball clay, natural gas liquids, and values indicated by symbol W	XX	20,763	XX	20,899	XX	23,291	XX	22,266
Total	XX	466,381	XX	498,364	XX	535,705	XX	534,863
LOUISIANA								
Clays, thousand short tons	909	$936	1,005	$983	995	$1,260	863	$1,163
Lime, do.	842	9,980	835	9,274	758	9,891	781	10,159
Natural gas, million cubic feet	4,466,786	812,955	5,081,435	929,902	5,716,857	1,057,619	6,416,015	1,212,627

See footnotes at end of table.

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1965		1966		1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
LOUISIANA—Continued								
Natural gas liquids:								
Natural gasoline and cycle products..thousand 42-gallon barrels..	34,091	$102,781	37,192	$113,802	41,777	$130,212	49,928	$156,903
LP gases..do....	30,953	46,101	34,993	72,016	43,921	92,284	57,165	91,464
Petroleum (crude)..do....	594,853	1,841,714	674,318	2,097,129	774,527	2,419,823	817,426	2,570,641
Salt..thousand short tons..	8,126	41,812	8,736	44,189	9,585	48,483	10,908	53,854
Sand and gravel..do....	14,298	16,405	18,216	22,504	20,312	27,442	20,411	26,504
Stone [4]..do....	7,452	10,905	8,091	11,253	7,599	11,174	9,387	11,785
Sulfur (Frasch process)..thousand long tons..	3,577	81,372	4,018	104,472	4,238	139,789	4,074	162,664
Value of items that cannot be disclosed: Cement, gypsum, and stone (crushed miscellaneous)....	XX	23,350	XX	24,616	XX	23,873	XX	23,246
Total....	XX	2,988,261	XX	3,430,140	XX	3,961,750	XX	4,321,010
MAINE								
Clays..thousand short tons..	49	$63	45	$58	42	$54	[3] 42	[3] $65
Gem stones....	NA	35	NA	35	NA	35	NA	35
Peat..short tons..	1,275	56	1,600	60	W	W	W	W
Sand and gravel..thousand short tons..	17,294	7,831	15,036	7,027	11,627	5,368	11,866	5,978
Stone..do....	1,100	3,409	1,092	3,622	1,159	2,999	1,187	3,205
Value of items that cannot be disclosed: Cement, fire clay (1968), copper (1968), feldspar, silver (1968), zinc (1968), and values indicated by symbol W....	XX	6,347	XX	5,932	XX	6,426	XX	8,527
Total....	XX	17,741	XX	16,734	XX	14,882	XX	17,810
MARYLAND								
Clays..thousand short tons..	[3] 914	[3] $1,088	[3] 856	[3] $1,084	998	$1,462	[3] 1,078	[3] $1,252
Coal (bituminous)..do....	1,210	4,339	1,222	4,367	1,305	4,548	1,447	5,318
Gem stones....	NA	3	NA	3	NA	3	NA	3
Lime..thousand short tons..	37	481	29	386	W	W	W	W
Natural gas..million cubic feet..	408	103	696	181	621	159	864	221
Peat..short tons..	W	W	W	W	W	W	5,554	94
Sand and gravel..thousand short tons..	16,200	21,188	15,108	20,383	12,868	17,724	11,719	17,157
Stone..do....	14,558	28,432	13,868	27,229	14,479	28,581	13,344	26,606
Value of items that cannot be disclosed: Cement, clays (ball clay 1965–66, 1968, fireclay 1968), greensand marl, potassium salts, talc and soapstone, and values indicated by symbol W....	XX	22,311	XX	20,528	XX	20,342	XX	21,193
Total....	XX	77,995	XX	74,161	XX	72,819	XX	71,844

MASSACHUSETTS								
Clays……thousand short tons	181	$238	202	$260	W	W	257	$314
Gem stones	NA	2	NA	2	NA	$2	NA	2
Lime……thousand short tons	170	2,779	182	2,712	195	3,044	198	3,380
Sand and gravel……do	22,141	16,172	17,321	17,846	17,881	19,504	17,799	20,106
Stone……do	6,168	16,980	6,424	17,624	6,203	17,724	6,917	19,501
Value of items that cannot be disclosed: Nonmetals and value indicated by symbol W	XX	27	XX	29	XX	338	XX	37
Total	XX	36,198	XX	38,473	XX	40,612	XX	43,340
MICHIGAN								
Cement:								
Portland……thousand 376-pound barrels	27,565	$86,996	28,171	$87,413	29,645	$94,515	31,375	$99,158
Masonry……thousand 280-pound barrels	2,108	5,373	2,032	5,221	1,995	5,296	2,006	5,527
Clays……thousand short tons	2,402	2,580	2,450	2,620	2,466	2,636	2,599	2,906
Copper (recoverable content of ores, etc.)……short tons	71,749	50,798	73,449	53,133	58,458	44,692	74,805	62,607
Gypsum……thousand short tons	1,338	5,027	1,522	5,489	1,422	5,085	1,405	5,196
Iron ore (usable)……thousand long tons, gross weight	13,527	145,482	14,377	157,377	14,130	162,610	12,699	148,890
Lime……thousand short tons	1,095	13,057	1,701	20,016	1,787	21,582	1,630	19,870
Magnesium compounds from sea water and brine (except for metal) short tons, MgO equivalent	319,389	26,143	342,482	28,105	309,446	26,388	266,406	25,087
Natural gas……million cubic feet	34,558	8,674	34,120	8,598	33,589	8,296	40,480	10,160
Natural gas liquids:								
Natural gasoline……thousand 42-gallon barrels	216	607	374	1,099	1,139	3,491	1,066	3,177
LP gases……do	1,817	3,815	1,898	4,385	1,414	3,444	1,384	3,432
Peat……short tons	230,950	2,134	235,842	2,175	237,107	2,292	237,513	2,919
Petroleum (crude)……thousand 42-gallon barrels	14,728	41,091	14,273	40,913	13,664	39,455	12,974	38,287
Salt……thousand short tons	4,171	36,087	4,465	38,611	4,789	42,389	4,893	44,481
Sand and gravel……do	53,168	47,176	55,123	49,521	52,310	49,616	56,663	54,979
Silver (recoverable content of ores, etc.)……thousand troy ounces	458	592	483	625	302	468	473	1,014
Stone……thousand short tons	34,713	36,438	37,864	40,380	36,432	39,910	37,279	41,092
Value of items that cannot be disclosed: Bromine, calcium-magnesium chloride, gem stones, iodine, and potassium salts	XX	53,490	XX	56,446	XX	58,039	XX	58,293
Total	XX	565,560	XX	602,127	XX	610,204	XX	627,075
MINNESOTA								
Clays [3]……thousand short tons	207	$311	224	$336	228	$342	240	$359
Iron ore (usable)……thousand long tons, gross weight	50,873	459,290	55,133	499,388	49,457	468,623	51,275	508,814
Manganiferous ore (5 to 35 percent Mn)……short tons, gross weight	280,705	W	275,581	W	236,753	W	191,846	W
Peat……short tons	7,346	123	11,366	197	13,968	257	6,400	96
Sand and gravel……thousand short tons	37,545	27,296	39,331	28,972	41,212	33,132	44,674	36,414
Stone……do	4,871	11,680	4,901	11,688	4,160	11,442	4,427	13,045

See footnotes at end of table.

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1965		1966		1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MINNESOTA—Continued								
Value of items that cannot be disclosed: Abrasive stones, cement, fire clay, gem stones, lime, and values indicated by symbol W	XX	$9,060	XX	$9,696	XX	$9,530	XX	$8,699
Total	XX	507,760	XX	550,277	XX	523,326	XX	567,427
MISSISSIPPI								
Clays .... thousand short tons	1,502	$6,997	1,727	$7,489	1,654	$7,852	1,693	$9,075
Natural gas .... million cubic feet	166,825	28,861	156,652	27,257	139,497	24,133	135,051	22,601
Natural gas liquids:								
Natural gasoline and cycle products ... thousand 42-gallon barrels	633	1,606	566	1,483	427	1,167	459	1,277
LP gases .... do	527	975	443	987	424	1,085	518	958
Petroleum (crude) .... do	56,183	148,437	55,227	146,353	57,147	155,726	58,708	164,396
Sand and gravel .... thousand short tons	8,447	8,717	12,675	13,563	14,039	15,485	11,980	12,669
Stone .... do	[4] 2,357	[4] 2,358	[4] 1,532	[4] 1,641	1,879	2,055	747	833
Value of items that cannot be disclosed: Cement, iron ore (1965–67), lime, magnesium compounds, and stone (dimension sandstone 1965–66)	XX	12,082	XX	12,587	XX	[r] 9,055	XX	9,146
Total	XX	210,033	XX	211,360	XX	[r] 216,558	XX	220,955
MISSOURI								
Barite .... thousand short tons	329	$4,219	337	$4,280	332	$4,444	284	$4,102
Cement:								
Portland .... thousand 376-pound barrels	13,334	46,034	13,848	46,228	15,044	52,119	20,081	71,206
Masonry .... thousand 280-pound barrels	377	1,173	382	1,075	372	1,172	405	1,312
Clays .... thousand short tons	2,226	5,439	2,329	5,989	2,305	6,220	2,433	6,158
Coal (bituminous) .... do	3,564	14,779	3,582	14,834	3,696	15,573	3,205	13,460
Copper (recoverable content of ores, etc.) .... short tons	2,331	1,650	3,913	2,831	3,215	2,458	5,494	4,598
Iron ore (usable) .... thousand long tons, gross weight	1,784	24,607	1,887	26,450	1,871	26,673	1,648	23,585
Lead (recoverable content of ores, etc.) .... short tons	133,521	41,659	132,255	39,981	152,649	42,742	212,611	56,180
Lime .... thousand short tons	1,442	16,782	1,494	17,910	W	W	W	W
Natural gas .... million cubic feet	84	21	---------	---------	121	30	14	4
Petroleum (crude) .... thousand 42-gallon barrels	73	W	97	W	W	W	W	W
Sand and gravel .... thousand short tons	12,068	13,735	10,702	13,540	9,716	12,556	10,649	14,204
Silver (recoverable content of ores, etc.) .... thousand troy ounces	300	387	---------	---------	226	351	341	731
Stone .... thousand short tons	36,247	53,574	35,240	53,393	36,585	53,953	38,763	58,522

Zinc (recoverable content of ores, etc.)__short tons__	4,312	1,259	3,968	1,151	7,430	2,057	12,301	3,321
Value of items that cannot be disclosed: Native asphalt, tripoli (1965), and values indicated by symbol W__	XX	250	XX	288	XX	[r] 16,662	XX	18,572
Total__	XX	225,568	XX	227,950	XX	[r] 237,010	XX	275,955
MONTANA								
Clays [3]__thousand short tons__	76	$98	53	$56	46	$50	30	$34
Coal (bituminous and lignite)__do__	364	1,050	419	1,290	371	996	519	1,214
Copper (recoverable content of ores, etc.)__short tons__	115,489	81,766	128,061	92,639	65,483	50,063	69,480	58,151
Gem stones__	NA	77	NA	109	NA	109	NA	109
Gold (recoverable content of ores, etc.)__troy ounces__	22,772	797	25,009	875	9,786	343	13,385	[5] 525
Iron ore (usable)__thousand long tons, gross weight__	9	71	12	93	10	81	12	W
Lead (recoverable content of ores, etc.)__short tons__	6,981	2,178	4,409	1,333	898	251	1,870	494
Lime__thousand short tons__	159	1,512	225	2,116	143	1,765	179	2,005
Manganese ore (35 percent or more Mn)__short tons, gross weight__	23,621	W	W	W	W	W	4,649	213
Manganiferous ore (5 to 35 percent Mn)__do__	1,968	W	1,755	28	2,763	16	2,063	22
Natural gas__million cubic feet__	28,105	2,305	30,685	2,547	25,866	2,173	19,313	1,757
Petroleum (crude)__thousand 42-gallon barrels__	32,778	79,624	35,380	86,273	34,959	87,543	48,460	124,488
Pumice__thousand short tons__	---------	---------	22	5	---------	---------	93	327
Sand and gravel__do__	12,048	13,587	13,816	13,523	12,339	10,655	8,762	7,754
Silver (recoverable content of ores, etc.)__thousand troy ounces__	5,207	6,733	5,320	6,878	2,066	3,203	2,133	4,574
Stone__thousand short tons__	5,512	5,971	4,150	5,212	4,782	6,037	3,314	4,878
Zinc (recoverable content of ores, etc.)__short tons__	33,786	9,866	29,120	8,445	3,341	925	3,778	1,020
Value of items that cannot be disclosed: Antimony (1966–67), barite (1965–66), cement, clays (bentonite), fluorspar, gypsum, natural gas liquids, peat, phosphate rock, talc, tungsten (1966–68), uranium ore (1966), vermiculite, and values indicated by symbol W__	XX	22,528	XX	23,846	XX	22,314	XX	20,566
Total__	XX	228,163	XX	245,268	XX	186,524	XX	228,131
NEBRASKA								
Clays__thousand short tons__	141	$141	153	$153	126	$142	148	$206
Gem stones__	NA	5	NA	5	NA	5	NA	4
Lime__thousand short tons__	W	W	W	W	W	W	28	W
Natural gas__million cubic feet__	10,720	1,565	10,196	1,621	8,453	1,454	8,129	1,423
Natural gas liquids:								
Natural gasoline__thousand 42-gallon barrels__	186	516	219	653	186	578	153	456
LP gases__do__	403	847	468	1,141	494	1,223	451	911
Petroleum (crude)__do__	17,216	45,796	13,850	37,673	13,373	36,775	13,183	36,781
Sand and gravel__thousand short tons__	11,993	13,697	13,539	14,179	11,739	10,878	13,013	13,175
Stone__do__	4,198	6,637	5,055	7,916	4,846	7,483	4,416	7,435
Value of items that cannot be disclosed: Cement, pumice, and values indicated by symbol W__	XX	14,622	XX	15,180	XX	12,330	XX	14,446
Total__	XX	83,826	XX	78,521	XX	70,868	XX	74,837

See footnotes at end of table.

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1965		1966		1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NEVADA								
Antimony ore and concentrate short tons, antimony content	26	$19	68	$63	53	$35	----------	----------
Barite thousand short tons	91	588	139	933	154	923	216	$1,511
Copper (recoverable content of ores, etc.) short tons	71,332	50,503	78,720	56,946	50,771	38,815	77,218	64,623
Gem stones	NA	100	NA	100	NA	100	NA	100
Gold (recoverable content of ores, etc.) troy ounces	229,050	8,017	366,903	12,842	434,993	15,225	317,382	[5] 12,460
Gypsum thousand short tons	710	2,518	594	2,023	409	1,412	552	1,534
Iron ore (usable) thousand long tons, gross weight	1,141	5,330	1,000	4,931	641	2,858	569	2,917
Lead (recoverable content of ores, etc.) short tons	2,277	710	3,581	1,083	1,500	420	863	228
Mercury 76-pound flasks	3,333	1,902	3,355	1,482	4,703	2,301	4,780	2,560
Perlite short tons	13,780	121	W	W	10,712	94	9,315	79
Petroleum (crude) thousand 42-gallon barrels	209	W	307	W	279	W	271	W
Pumice thousand short tons	68	187	55	190	105	236	62	144
Sand and gravel do	9,455	11,796	9,085	9,184	10,166	8,644	7,812	10,442
Silver (recoverable content of ores, etc.) thousand troy ounces	507	656	867	1,122	566	877	645	1,384
Stone thousand short tons	1,248	2,247	2,002	2,519	1,375	2,145	1,325	2,041
Sulfur ore long tons	336	6	----------	----------	----------	----------	----------	----------
Talc and soapstone short tons	3,592	31	4,715	24	2,096	17	3,029	38
Tungsten ore and concentrate short tons, 60 percent WO_3 basis	W	W	W	W	W	W	25	58
Zinc (recoverable content of ores, etc.) short tons	3,858	1,127	5,827	1,690	3,085	840	2,104	568
Value of items that cannot be disclosed: Brucite, cement, clays, diatomite, fluorspar, lime, lithium minerals (1966–68), magnesite, molybdenum, peat (1965–67), salt, uranium (1965–66), and values indicated by symbol W	XX	14,142	XX	17,555	XX	15,941	XX	19,854
Total	XX	99,995	XX	112,637	XX	90,883	XX	120,041
NEW HAMPSHIRE								
Clays thousand short tons	53	$47	51	$51	42	$42	41	$41
Mica, sheet pounds	----------	----------	----------	----------	16,000	W	----------	----------
Peat short tons	----------	----------	175	2	50	(6)	----------	----------
Sand and gravel thousand short tons	10,584	5,559	7,626	4,807	8,449	5,137	7,742	5,698
Stone do	153	1,932	206	2,091	473	2,887	383	3,377
Value of items that cannot be disclosed: Other nonmetals	XX	127	XX	49	XX	51	XX	50
Total	XX	7,665	XX	7,000	XX	8,117	XX	9,166
NEW JERSEY								
Clays thousand short tons	506	$1,388	488	$1,319	437	$1,189	378	$1,008

Gem stones		NA	10	NA	10	NA	10	NA	10
Peat	short tons	40,480	431	36,312	489	43,045	542	55,786	621
Sand and gravel	thousand short tons	17,389	28,646	17,782	29,822	18,626	29,975	20,806	33,570
Stone	do	12,282	27,247	12,453	28,056	12,611	28,253	13,151	30,343
Zinc (recoverable content of ores, etc.)[10]	short tons	38,297	11,106	25,287	7,319	26,041	7,081	25,668	6,930
Value of items that cannot be disclosed: Iron ore (1965–67), lime, magnesium compounds, manganiferous residuum, greensand marl, and titanium concentrate		XX	11,330	XX	9,080	XX	5,747	XX	4,984
Total		XX	80,158	XX	75,595	XX	72,747	XX	77,466

NEW MEXICO

Barite	thousand short tons	(6)	$2	----------	----------	----------	----------	----------	----------
Carbon dioxide, natural	thousand cubic feet	883,819	62	795,885	$58	771,516	$57	749,864	$52
Clays	thousand short tons	60	101	W	W	46	74	66	89
Coal (bituminous)	do	3,212	10,710	2,755	9,110	3,463	12,641	3,429	13,507
Copper (recoverable content of ores, etc.)	short tons	98,658	69,850	108,614	78,571	75,008	57,345	90,769	75,968
Feldspar	long tons	----------	----------	----------	----------	----------	----------	98	W
Gem stones		NA	45	NA	45	NA	60	NA	59
Gold (recoverable content of ores, etc.)	troy ounces	9,641	337	9,295	325	5,188	182	6,630	[5] 260
Gypsum	thousand short tons	W	W	146	545	155	588	146	549
Helium, grade A	thousand cubic feet	80,583	2,821	95,900	3,357	71,200	2,492	39,100	1,355
Iron ore (usable)	thousand long tons, gross weight	W	W	W	W	W	W	17	113
Lead (recoverable content of ores, etc.)	short tons	3,387	1,057	1,596	482	1,827	512	1,363	360
Lime	thousand short tons	33	465	34	472	17	243	27	377
Manganese ore (35 percent or more Mn)	short tons, gross weight	5,637	156	W	W	W	W	6,729	W
Manganiferous ore (5 to 35 percent Mn)	do	50,090	328	47,590	324	49,323	348	50,681	379
Mica: Scrap	short tons	4,263	45	W	W	W	W	W	W
Natural gas	million cubic feet	987,205	110,590	998,076	124,760	1,067,510	138,776	1,164,182	156,000
Natural gas liquids:									
Natural gasoline and cycle products	thousand 42-gallon barrels	8,535	20,824	8,065	19,736	8,050	20,730	8,868	23,104
LP gases	do	18,079	25,817	19,433	31,832	21,647	40,003	23,802	34,989
Peat	short tons	----------	----------	----------	----------	----------	----------	446	4
Perlite	do	331,011	2,905	343,334	3,423	346,586	3,424	365,481	3,706
Petroleum (crude)	thousand 42-gallon barrels	119,166	334,977	124,154	352,101	126,144	368,340	128,550	378,708
Potassium salts	thousand short tons, K_2O equivalent	2,848	117,771	2,953	108,653	2,883	91,098	2,289	63,406
Pumice	thousand short tons	264	915	245	787	220	639	243	527
Salt	do	64	572	66	716	82	1,036	W	W
Sand and gravel	do	11,763	12,130	15,503	13,029	14,672	14,336	12,262	12,396
Silver (recoverable content of ores, etc.)	thousand troy ounces	288	372	243	314	157	244	225	482
Stone	thousand short tons	1,911	3,020	2,652	4,056	1,891	2,403	2,226	3,527
Uranium (recoverable content U_3O_8)	thousand pounds	W	W	9,340	74,721	11,202	89,615	12,282	95,144
Vanadium (recoverable in ore and concentrate)	short tons	W	221	W	53	W	W	W	W
Zinc (recoverable content of ores, etc.)	do	36,460	10,646	29,296	8,496	21,380	5,919	18,686	5,045
Value of items that cannot be disclosed: Beryllium (1968), cement, fluorspar (1967–68), molybdenum, tin (1965–66), and values indicated by symbol W		XX	79,936	XX	20,328	XX	23,001	XX	23,669
Total		XX	806,675	XX	856,294	XX	874,106	XX	893,775

See footnotes at end of table.

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1965 Quantity	1965 Value (thousands)	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
NEW YORK								
Clays thousand short tons	1,354	$1,717	1,464	$1,726	1,506	$1,814	1,675	$1,790
Emery short tons	10,720	204	11,102	210	W	W	W	W
Gem stones	NA	10	NA	10	NA	10	NA	10
Gypsum thousand short tons	662	3,511	559	2,998	570	3,118	570	2,925
Lead (recoverable content of ores, etc.) short tons	601	188	1,097	332	1,653	463	1,396	369
Lime thousand short tons	W	W	1,096	9,870	1,139	10,570	1,086	10,154
Natural gas million cubic feet	3,340	1,029	2,699	837	3,837	1,201	4,632	1,390
Peat short tons	25,098	282	27,211	250	23,053	282	14,888	153
Petroleum (crude) thousand 42-gallon barrels	1,632	7,246	1,735	7,925	1,972	9,026	1,532	7,093
Salt thousand short tons	5,002	35,771	4,980	36,203	5,320	41,568	5,218	42,488
Sand and gravel do	39,225	40,370	41,903	43,091	43,500	44,499	43,439	45,812
Silver (recoverable content of ores, etc.) thousand troy ounces	11	15	22	28	31	48	28	59
Stone thousand short tons	30,801	48,675	34,130	54,548	33,889	56,615	35,441	63,510
Zinc (recoverable content of ores, etc.) short tons	69,880	20,405	73,454	21,302	70,555	19,584	66,194	17,872
Value of items that cannot be disclosed: Cement, abrasive garnet, iron ore, talc, titanium concentrate, wollastonite, and values indicated by symbol W	XX	130,684	XX	121,482	XX	110,620	XX	106,011
Total	XX	290,057	XX	300,807	XX	299,318	XX	299,636
NORTH CAROLINA								
Barite thousand short tons	---------	---------	---------	---------	1	$6	W	W
Clays [3] do	3,883	$2,162	3,381	$2,241	2,977	2,012	3,310	$2,148
Feldspar long tons	278,990	3,153	301,610	3,157	265,690	3,113	316,862	4,340
Gem stones	NA	15	NA	15	NA	25	NA	20
Mica:								
Scrap short tons	72,199	1,987	63,480	2,348	69,639	1,751	69,054	1,640
Sheet pounds	718,293	185	4,500	1	4,500	W	15,000	W
Sand and gravel thousand short tons	10,499	10,076	11,601	11,132	10,014	9,962	10,771	11,178
Stone do	[4] 18,835	[4] 30,920	[4] 22,377	[4] 36,136	24,507	41,488	24,543	42,429
Talc and pyrophyllite short tons	109,721	556	113,366	576	109,398	518	100,030	520
Value of items that cannot be disclosed: Asbestos, cement, clay (kaolin), lithium minerals, olivine, phosphate rock (1966–68), stone (crushed and dimension marble 1965–66, and dimension slate 1965–66), and values indicated by symbol W	XX	11,829	XX	16,272	XX	18,224	XX	20,544
Total	XX	60,388	XX	71,878	XX	77,094	XX	82,819

NORTH DAKOTA								
Clays, thousand short tons	81	$114	76	$100	W	W	W	W
Coal (lignite), do	2,732	5,848	3,543	6,976	4,156	$7,967	4,487	$7,986
Gem stones	NA	1	NA	1	NA	1	NA	1
Natural gas, million cubic feet	35,652	5,704	46,585	7,547	40,462	6,636	41,023	6,769
Natural gas liquids:								
Natural gasoline, thousand 42-gallon barrels	501	1,263	552	1,415	554	1,443	558	1,479
LP gases, do	2,028	3,066	2,188	3,859	2,111	3,901	2,156	3,622
Petroleum (crude), do	26,350	65,875	27,126	69,170	25,315	65,818	25,040	66,106
Sand and gravel, thousand short tons	7,574	7,895	10,145	10,568	8,822	9,118	10,839	10,159
Stone, do	356	624	170	305	596	1,092	165	326
Value of items that cannot be disclosed: Lime, molybdenum (1965–67), peat, salt, uranium, vanadium (1965), and values indicated by symbol W	XX	3,403	XX	2,327	XX	1,562	XX	1,588
Total	XX	93,793	XX	102,268	XX	97,538	XX	98,036
OHIO								
Cement:								
Portland, thousand 376-pound barrels	14,786	$47,499	15,181	$48,740	14,726	$46,860	15,222	$49,814
Masonry, thousand 280-pound barrels	1,050	3,004	976	2,785	946	2,730	1,063	3,155
Clays, thousand short tons	5,070	14,816	5,089	14,522	4,670	15,185	4,750	15,216
Coal (bituminous), do	39,390	146,028	43,341	164,444	46,014	176,921	48,323	191,427
Gem stones	NA	3	NA	3	NA	3	NA	3
Lime, thousand short tons	3,831	53,208	3,858	50,997	3,636	48,817	3,701	49,367
Natural gas, million cubic feet	35,684	8,421	43,133	10,223	41,315	9,957	42,673	10,540
Peat, short tons	5,352	80	5,214	84	7,301	100	6,506	94
Petroleum (crude), thousand 42-gallon barrels	12,908	37,940	10,899	32,700	9,924	31,427	11,204	35,722
Salt, thousand short tons	5,026	34,816	5,138	35,735	5,407	39,549	5,713	43,172
Sand and gravel, do	40,852	49,305	43,851	52,909	43,196	52,888	46,734	57,671
Stone, do	42,263	66,969	45,002	72,900	45,458	72,534	[4]48,057	[4]78,830
Value of items that cannot be disclosed: Abrasive stone, gypsum, stone (dimension limestone 1968)	XX	2,163	XX	1,998	XX	1,917	XX	1,887
Total	XX	464,252	XX	488,040	XX	498,888	XX	536,898
OKLAHOMA								
Clays [3], thousand short tons	794	$806	745	$754	744	$869	726	$967
Coal (bituminous), do	974	5,520	843	4,935	823	4,703	1,089	6,401
Gypsum, do	761	2,343	785	2,212	804	2,266	931	2,565
Helium, grade A, thousand cubic feet	310,700	10,874	352,400	12,333	309,100	9,885	308,600	8,700
Lead (recoverable content of ores, etc.), short tons	2,813	878	2,999	907	2,727	764	2,387	631
Natural gas, million cubic feet	1,320,995	182,297	1,351,225	189,172	1,412,952	202,052	1,390,884	197,506
Natural gas liquids:								
Natural gasoline and cycle products, thousand 42-gallon barrels	13,575	34,561	13,717	35,715	13,545	35,846	13,905	38,829
LP gases, do	21,302	32,208	23,482	44,381	23,944	49,276	25,497	39,520

See footnotes at end of table.

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1965 Quantity	1965 Value (thousands)	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
OKLAHOMA—Continued								
Petroleum (crude) thousand 42-gallon barrels	208,441	$587,944	224,839	$654,281	230,749	$676,095	228,623	$668,202
Salt thousand short tons	9	65	W	W	10	76	7	44
Sand and gravel do	5,218	6,023	6,040	7,565	4,540	5,280	5,041	6,288
Stone do	16,417	18,071	15,384	17,393	16,355	18,932	17,290	21,950
Zinc (recoverable content of ores, etc.) short tons	12,715	3,713	11,237	3,259	10,670	2,954	6,921	1,869
Value of items that cannot be disclosed: Cement, clay (bentonite), copper, lime, pumice, silver, tripoli, and values indicated by symbol W	XX	23,953	XX	24,484	XX	23,178	XX	23,360
Total	XX	909,256	XX	997,391	XX	1,032,126	XX	1,016,832
OREGON								
Clays thousand short tons	291	$359	361	$362	[3] 295	[3] $295	[3] 218	[3] $284
Diatomite short tons	W	W	W	W	108	2	120	W
Gem stones	NA	750	NA	750	NA	750	NA	750
Gold (recoverable content of ores, etc.) troy ounces	499	17	281	10	186	7	28	[5] 1
Lime thousand short tons	98	1,858	116	2,283	99	2,059	120	2,407
Mercury 76-pound flasks	1,364	779	700	309	948	461	938	502
Nickel (content of ore and concentrate) short tons	16,188	W	15,086	W	15,287	W	17,294	W
Peat do	---------	---------	900	17	W	W	860	11
Perlite do	---------	---------	W	W	8	(6)	---------	---------
Pumice thousand short tons	657	1,181	714	1,256	834	1,195	725	977
Sand and gravel do	21,800	32,849	35,827	34,986	19,630	25,250	18,260	21,457
Silver (recoverable content of ores, etc.) thousand troy ounces	9	11	(6)	(6)	(6)	(6)	(6)	1
Stone thousand short tons	21,212	27,301	33,288	48,335	13,201	20,256	14,812	21,168
Talc and soapstone short tons	---------	---------	---------	---------	W	W	3	1
Value of items that cannot be disclosed: Cement, clay (fire clay 1967–68), copper (1965–66, 1968), iron ore (pigment material 1965–66), lead (1965, 1968), zinc (1965), and values indicated by symbol W	XX	17,866	XX	19,176	XX	16,285	XX	16,890
Total	XX	82,966	XX	107,484	XX	66,560	XX	64,449
PENNSYLVANIA								
Cement:								
Portland thousand 376-pound barrels	40,153	$116,925	40,004	$114,357	40,197	$114,592	43,018	$123,176
Masonry thousand 280-pound barrels	3,006	7,991	2,960	7,860	2,929	7,948	3,151	8,706
Clays[3] thousand short tons	3,394	17,697	3,293	17,033	2,994	16,703	3,034	17,679
Coal:								
Anthracite do	14,866	122,021	12,941	100,663	12,256	96,160	11,461	97,245
Bituminous do	80,308	407,267	81,443	425,168	79,412	419,345	76,200	408,982

Copper (recoverable content of ores, etc.) short tons	4,354	3,083	3,178	2,299	4,401	3,365	4,850	4,059
Gem stones	NA	4	NA	4	NA	4	NA	4
Lime thousand short tons	1,568	22,496	1,585	22,816	1,719	24,715	1,702	24,272
Natural gas million cubic feet	84,461	22,551	90,914	25,820	89,966	25,280	87,987	24,460
Natural gas liquids:								
Natural gasoline thousand 42-gallon barrels	24	55	76	186	28	77	27	73
LP gases do	40	109	44	121	42	114	37	95
Peat short tons	45,600	527	52,912	562	39,505	437	35,806	385
Petroleum (crude) thousand 42-gallon barrels	4,922	21,263	4,337	19,300	4,387	19,701	4,160	18,698
Sand and gravel thousand short tons	18,502	29,606	17,567	29,562	17,479	29,614	18,101	31,076
Stone do	56,806	99,627	59,088	99,233	60,155	108,157	62,812	108,151
Zinc (recoverable content of ores, etc.)[10] short tons	27,635	8,014	28,080	8,143	35,067	9,468	30,382	8,203
Value of items that cannot be disclosed: Clays (kaolin), cobalt, gold, iron ore, scrap mica, pyrites, pyrophyllite, silver, and tripoli	XX	34,587	XX	30,281	XX	27,718	XX	28,780
Total	XX	913,823	XX	903,408	XX	898,398	XX	904,044

RHODE ISLAND

Sand and gravel thousand short tons	1,681	$1,811	2,276	$2,212	2,334	$2,416	2,291	$2,546
Stone do	437	1,119	535	1,734	481	1,618	W	W
Value of items that cannot be disclosed: Other nonmetals and values indicated by symbol W	XX	1	XX	1	XX	1	XX	1,676
Total	XX	2,931	XX	3,947	XX	4,035	XX	4,222

SOUTH CAROLINA

Clays thousand short tons	1,837	$8,539	2,139	$8,830	1,733	$8,048	1,936	$8,923
Sand and gravel do	5,248	6,688	6,016	7,668	5,248	7,178	5,662	8,074
Stone do	[4] 5,948	[4] 8,447	8,129	12,510	[4] 8,310	[4] 12,366	8,942	13,717
Value of items that cannot be disclosed: Barite (1965–66), cement, feldspar, kyanite, scrap mica, peat, pyrites, stone (crushed limestone 1965 and dimension granite 1965, 1967), and vermiculite	XX	17,587	XX	16,585	XX	20,682	XX	21,144
Total	XX	41,261	XX	45,593	XX	48,274	XX	51,858

SOUTH DAKOTA

Beryllium concentrate short tons, gross weight	W	W	124	$40	W	W	75	$35
Cement:								
Portland thousand 376-pound barrels	1,575	$5,127	1,974	6,367	1,406	$4,815	1,826	6,228
Masonry thousand 280-pound barrels	55	180	51	170	54	178	54	180
Clays thousand short tons	223	1,220	231	870	199	799	226	1,119
Coal (lignite) do	10	49	10	45	5	27	--------	--------
Feldspar long tons	51,560	346	53,810	369	61,411	420	39,077	264
Gem stones	NA	20	NA	20	NA	30	NA	34
Gold (recoverable content of ores, etc.) troy ounces	628,259	21,989	606,467	21,226	601,785	21,062	593,052	[5] 23,288
Gypsum thousand short tons	7	27	17	68	12	49	16	65
Lithium minerals short tons	150	• 5	W	W	W	W	W	W
Petroleum (crude) thousand 42-gallon barrels	219	488	239	479	211	502	187	401
Sand and gravel thousand short tons	13,998	14,155	13,630	13,585	13,463	13,737	11,558	11,578

See footnotes at end of table.

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1965 Quantity	1965 Value (thousands)	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
SOUTH DAKOTA—Continued								
Silver (recoverable content of ores, etc.)........thousand troy ounces..	129	$167	110	$142	121	$188	138	$295
Stone........thousand short tons..	1,554	5,387	2,186	7,995	1,866	9,694	1,860	9,687
Value of items that cannot be disclosed: Columbium-tantalum concentrates (1967), lime, scrap mica, molybdenum (1965–67), tin (1966), uranium, vanadium (1965–67), and values indicated by symbol W...	XX	1,553	XX	1,796	XX	1,117	XX	917
Total........	XX	50,663	XX	53,172	XX	52,618	XX	54,086
TENNESSEE								
Barite........thousand short tons..	31	$442	29	$412	15	$235	21	$362
Cement:								
Portland........thousand 376-pound barrels..	8,724	27,535	8,177	25,718	8,062	25,548	8,488	27,691
Masonry........thousand 280-pound barrels..	1,185	3,140	1,095	2,822	1,092	2,992	1,870	3,836
Clays........thousand short tons..	1,495	6,103	[3] 1,859	[3] 4,909	1,574	5,152	[3] 1,562	[3] 5,772
Coal (bituminous)........do....	5,865	20,930	6,309	23,763	6,882	26,974	8,148	29,647
Copper (recoverable content of ores, etc.)........short tons..	14,823	10,495	15,410	11,148	14,600	11,162	14,196	11,881
Gold (recoverable content of ores, etc.)........troy ounces..	122	4	141	5	181	6	140	[5] 5
Lead (recoverable content of ores, etc.)........short tons..	--------	--------	181	55	--------	--------	--------	--------
Natural gas........million cubic feet..	85	16	--------	--------	58	11	48	9
Petroleum (crude)........thousand 42-gallon barrels..	11	W	7	W	7	W	6	W
Phosphate rock........thousand short tons..	2,954	22,296	3,125	23,886	2,992	22,571	3,149	23,628
Sand and gravel........do....	8,193	10,690	8,628	11,142	7,975	10,679	7,344	11,140
Silver (recoverable content of ores, etc.)........thousand troy ounces..	94	122	101	130	130	202	90	192
Stone[4]........thousand short tons..	28,888	38,859	31,260	41,432	31,463	41,958	32,083	43,854
Zinc (recoverable content of ores, etc.)........short tons..	122,387	35,737	103,117	29,904	113,065	31,303	124,089	33,491
Value of items that cannot be disclosed: Clay (fuller's earth 1966–68), lime, pyrites, stone (crushed sandstone, dimension sandstone 1967), and values indicated by symbol W........	XX	6,572	XX	7,258	XX	10,779	XX	9,826
Total........	XX	182,941	XX	182,584	XX	189,572	XX	201,334
TEXAS								
Cement:								
Portland........thousand 376-pound barrels..	30,820	$97,598	30,827	$97,188	31,944	$99,329	34,499	$107,582
Masonry........thousand 280-pound barrels..	968	3,011	884	2,872	888	2,847	1,059	3,371
Clays........thousand short tons..	[3] 4,469	[3] 6,865	4,516	7,187	4,497	8,081	4,687	8,860

Gem stones	NA	150	NA	150	NA	150	NA	150
Gypsum .... thousand short tons	1,045	3,794	899	3,258	984	3,419	1,039	3,616
Helium: Crude .... thousand cubic feet	1,015,708	10,330	1,030,500	10,605	977,600	10,246	1,088,700	11,100
Grade A .... do	350,000	12,250	364,100	12,744	335,900	9,900	362,100	9,400
Lime .... thousand short tons	1,338	19,668	1,473	18,696	1,564	20,713	1,564	21,154
Natural gas .... million cubic feet	6,636,555	858,396	6,953,790	903,993	7,188,900	948,935	7,495,414	1,011,881
Natural gas liquids:								
Natural gasoline and cycle products .... thousand 42-gallon barrels	89,821	256,959	92,625	269,332	95,991	277,105	97,075	269,182
LP gases .... do	139,229	204,666	151,425	260,755	177,367	320,326	189,162	278,068
Perlite .... short tons	1,000	8	W	W	W	W	---------	---------
Petroleum (crude) .... thousand 42-gallon barrels	1,000,749	2,962,119	1,057,706	3,141,387	1,119,962	3,375,565	1,133,380	3,450,707
Salt .... thousand short tons	6,964	30,771	7,724	33,797	8,344	36,435	8,534	42,663
Sand and gravel .... do	32,649	36,075	26,222	31,313	31,398	39,170	31,843	41,546
Stone .... do	39,520	53,659	43,578	56,659	49,424	61,577	48,480	58,006
Sulfur (Frasch process) .... thousand long tons	3,674	83,282	3,703	96,820	3,448	111,931	2,571	105,482
Talc and soapstone .... short tons	64,211	204	102,399	367	90,836	356	125,880	517
Value of items that cannot be disclosed: Native asphalt, barite (1965–66), bromine, clays (fuller's earth 1965), coal (lignite), graphite, iron ore, magnesium chloride (for metal), magnesium compounds (except for metal), mercury, pumice, sodium sulfate, uranium, vermiculite (1967–68), and values indicated by symbol W	XX	79,026	XX	74,918	XX	80,286	XX	82,596
Total	XX	4,718,826	XX	5,022,041	XX	5,406,371	XX	5,505,831

UTAH

Carbon dioxide, natural .... thousand cubic feet	86,201	$6	94,006	$7	65,664	$5	57,747	$4
Clays [3] .... thousand short tons	149	332	89	240	114	288	160	476
Coal (bituminous) .... do	4,992	31,811	4,635	26,763	4,175	24,281	4,316	24,893
Copper (recoverable content of ores, etc.) .... short tons	259,138	183,470	265,383	191,978	168,609	128,905	228,245	191,027
Fluorspar .... do	W	W	W	W	W	W	8,762	213
Gem stones	NA	75	NA	75	NA	80	NA	83
Gold (recoverable content of ores, etc.) .... troy ounces	426,299	14,921	438,736	15,356	288,350	10,092	334,419	[5] 13,129
Iron ore (usable) .... thousand long tons, gross weight	2,139	14,229	1,956	13,478	1,708	11,916	1,764	11,281
Lead (recoverable content of ores, etc.) .... short tons	37,700	11,762	64,124	19,385	53,813	15,068	45,205	11,945
Lime .... thousand short tons	189	3,470	200	3,640	169	3,182	174	3,439
Natural gas .... million cubic feet	71,616	8,952	69,366	8,809	48,965	6,463	46,151	7,292
Petroleum (crude) .... thousand 42-gallon barrels	25,298	66,045	24,112	63,760	24,048	63,221	23,504	62,826
Pumice .... thousand short tons	W	W	W	W	W	W	8	19
Salt .... do	384	3,591	427	3,770	403	3,525	405	3,756
Sand and gravel .... do	10,032	10,464	12,368	12,937	9,412	8,631	10,293	9,364
Silver (recoverable content of ores, etc.) .... thousand troy ounces	5,636	7,287	7,755	10,028	4,875	7,556	5,121	10,982
Stone .... thousand short tons	2,328	4,765	2,246	4,269	1,831	4,108	1,953	4,312
Sulfur ore .... long tons, gross weight	2,156	3	---------	---------	---------	---------	---------	---------
Uranium (recoverable content U_3O_8) .... thousand pounds	W	W	1,225	9,797	1,287	10,300	1,712	13,175
Vanadium (recoverable in ore and concentrate) .... short tons	387	1,353	353	1,519	471	2,024	563	2,010
Zinc (recoverable content of ores, etc.) .... do	27,747	8,102	37,323	10,824	34,251	9,483	33,153	8,951
Value of items that cannot be disclosed: Asphalt (gilsonite), cement, clays (fire clay 1965–67, kaolin), gypsum, magnesium compounds (1966–68), molybdenum, natural gas liquids, perlite (1965–67), phosphate rock, potassium salts, pyrites (1966–68), tungsten concentrate (1967–68), and values indicated by symbol W	XX	68,510	XX	52,243	XX	45,349	XX	44,774
Total	XX	439,148	XX	448,878	XX	354,477	XX	423,951

See footnotes at end of table.

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1965		1966		1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
VERMONT								
Peat short tons	780	$3	333	$5	280	$4	W	W
Sand and gravel thousand short tons	2,084	1,670	2,323	1,744	3,718	2,178	3,587	$2,806
Stone do	2,591	21,564	2,650	19,926	2,761	20,520	2,536	21,401
Value of items that cannot be disclosed: Asbestos, clays, gem stones, lime, talc, and values indicated by symbol W	XX	4,155	XX	4,235	XX	4,566	XX	4,508
Total	XX	27,392	XX	25,910	XX	27,268	XX	28,715
VIRGINIA								
Clays thousand short tons	1,415	$1,657	1,486	$1,813	1,382	$1,623	1,462	$1,714
Coal (bituminous) do	34,053	139,291	35,565	153,341	36,721	171,183	36,966	178,946
Gem stones	NA	7	NA	7	NA	7	NA	7
Lead (recoverable content of ores, etc.) short tons	3,651	1,139	3,078	930	3,430	960	3,573	944
Lime thousand short tons	847	10,584	840	10,486	829	10,345	919	11,138
Natural gas million cubic feet	3,152	942	4,249	1,275	3,818	1,149	3,389	1,013
Petroleum (crude) thousand 42-gallon barrels	4	W	1	W	3	W	3	W
Sand and gravel thousand short tons	15,322	18,019	17,191	16,635	9,863	12,494	10,859	13,644
Soapstone short tons	3,549	9	3,989	10	W	W	3,928	10
Stone thousand short tons	36,350	59,397	34,151	55,550	31,824	52,470	31,217	53,533
Zinc (recoverable content of ores, etc.)[10] short tons	20,491	5,942	17,666	5,123	18,846	5,088	19,257	5,199
Value of items that cannot be disclosed: Aplite, cement, feldspar, gypsum, iron ore (pigment materials), kyanite, salt, titanium concentrate, and values indicated by symbol W	XX	30,990	XX	29,127	XX	28,366	XX	29,515
Total	XX	267,977	XX	274,297	XX	283,685	XX	295,663
WASHINGTON								
Barite thousand short tons	(6)	$1	---------	---------	(6)	$1	---------	---------
Carbon dioxide thousand cubic feet	11,848	3	W	W	W	W	---------	---------
Cement:								
Portland thousand 376-pound barrels	6,258	22,351	6,820	$24,340	5,614	20,581	6,328	$23,030
Masonry thousand 280-pound barrels	62	201	60	187	65	200	56	175
Clays[3] thousand short tons	162	211	185	249	139	203	140	213
Coal (bituminous) do	55	497	59	514	59	517	178	823
Copper (recoverable content of ores, etc.) short tons	30	21	34	25	21	16	22	18
Gem stones	NA	75	NA	75	NA	75	NA	100
Lead (recoverable content of ores, etc.) short tons	6,328	1,974	5,859	1,771	2,762	773	5,655	1,494

Peat……do……	29,729	131	25,599	136	40,608	181	40,440	159
Sand and gravel……thousand short tons……	31,801	27,234	29,002	26,806	28,164	27,520	31,432	27,839
Stone……do……	12,461	17,446	13,250	20,273	14,454	19,099	14,331	16,690
Talc and soapstone……short tons……	2,861	17	3,880	22	4,916	26	W	W
Zinc (recoverable content of ores, etc.)……do……	22,230	6,491	24,772	7,184	21,540	5,964	13,884	3,749
Value of items that cannot be disclosed: Clays (fire clay, bentonite 1965), diatomite, gold, gypsum (1966–68), lime, magnesite, mercury (1965, 1968), olivine, pumice, silver, tungsten (1965, 1967), uranium (1965–66), vanadium (1966), and values indicated by symbol W……	XX	11,011	XX	7,514	XX	6,911	XX	7,095
Total……	XX	87,664	XX	89,096	XX	82,067	XX	81,385
WEST VIRGINIA								
Clays [3]……thousand short tons……	289	$328	300	$334	245	$254	193	$219
Coal (bituminous)……do……	149,191	726,096	149,681	753,851	153,749	800,683	145,921	775,720
Lime……do……	W	W	240	3,492	217	3,099	207	2,848
Natural gas……million cubic feet……	207,416	48,743	211,610	49,940	211,460	50,962	236,971	62,086
Petroleum (crude)……thousand 42-gallon barrels……	3,530	13,591	3,674	14,623	3,561	14,244	3,312	13,149
Salt……thousand short tons……	1,153	5,539	1,147	5,446	1,127	5,137	1,308	4,971
Sand and gravel……do……	5,253	11,480	5,448	11,569	5,827	12,167	5,657	11,900
Stone [4]……do……	8,482	14,587	9,738	16,354	9,445	16,447	9,011	16,789
Value of items that cannot be disclosed: Calcium-magnesium chloride (1965–67), cement, clay (fire clay), gem stones, natural gas liquids, stone (dimension sandstone) and values indicated by symbol W……	XX	39,240	XX	36,191	XX	34,865	XX	30,026
Total……	XX	859,604	XX	891,800	XX	937,858	XX	917,708
WISCONSIN								
Clays……thousand short tons……	119	$147	123	$148	89	$112	17	$34
Iron ore (usable)……thousand long tons, gross weight……	141	W	------	------	------	------	------	------
Lead (recoverable content of ores, etc.)……short tons……	1,645	513	1,694	512	1,596	447	1,126	298
Lime……thousand short tons……	197	3,076	204	3,186	212	3,414	224	3,620
Peat……short tons……	3,090	122	2,379	164	1,823	W	1,902	153
Sand and gravel……thousand short tons……	38,751	27,707	41,523	30,713	42,542	32,955	39,807	30,908
Stone……do……	15,344	21,924	16,150	23,735	17,122	24,863	17,000	25,228
Zinc (recoverable content of ores, etc.)……short tons……	26,993	7,882	24,775	7,185	28,953	8,016	25,711	6,942
Value of items that cannot be disclosed: Abrasive stones, cement, gem stones, and values indicated by symbol W……	XX	11,628	XX	10,367	XX	9,805	XX	4,522
Total……	XX	72,999	XX	76,010	XX	79,612	XX	71,695
WYOMING								
Clays……thousand short tons……	1,352	$13,633	1,559	$15,874	1,495	$14,313	1,828	$17,275
Coal (bituminous)……do……	3,260	10,150	3,670	11,840	3,588	11,876	3,829	12,117
Copper (recoverable content of ores, etc.)……short tons……	6	4	------	------	------	------	------	------

See footnotes at end of table.

Table 5.—Mineral production[1] in the United States, by States—Continued

Mineral	1965		1966		1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
	WYOMING—Continued							
Gem stones	NA	$120	NA	$120	NA	$125	NA	$127
Gold (recoverable content of ores, etc.) troy ounces	3	(6)	---------	---------	---------	---------	---------	---------
Iron ore (usable) thousand long tons, gross weight	2,087	25,198	1,978	19,700	1,854	19,186	1,967	19,452
Lime thousand short tons	W	W	W	W	W	W	28	W
Natural gas million cubic feet	235,849	31,840	243,381	35,290	240,074	35,051	248,481	36,278
Natural gas liquids:								
Natural gasoline thousand 42-gallon barrels	2,264	6,195	2,295	6,281	2,361	6,447	2,331	6,501
LP gases do	3,413	6,020	3,954	7,308	4,139	7,648	3,917	7,090
Petroleum (crude) do	138,314	345,785	134,470	344,243	136,312	351,685	144,250	380,589
Sand and gravel thousand short tons	7,996	8,873	7,187	7,496	8,181	8,253	9,350	8,973
Stone do	1,594	2,791	1,393	2,560	1,246	2,375	1,434	2,754
Uranium (recoverable content U_3O_8) thousand pounds	W	W	4,593	36,741	4,655	37,248	5,928	44,343
Vanadium (recoverable in ore and concentrate) short tons	W	444	W	555	W	W	---------	---------
Value of items that cannot be disclosed: Beryllium concentrate (1965), cement, feldspar, gypsum, phosphate rock, pumice (1967), silver (1965), sodium carbonates and sulfates, vermiculite (1967), and values indicated by symbol W	XX	64,901	XX	36,379	XX	36,494	XX	40,691
Total	XX	515,454	XX	524,387	XX	530,696	XX	576,190

[e] Estimate. [r] Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data. XX Not applicbale.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes certain cement, included with "Value of items that cannot be disclosed."

[3] Excludes certain clays, included with "Value of items that cannot be disclosed."

[4] Excludes certain stone, included with "Value of items that cannot be disclosed."

[5] Based on average U. S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968, and the New York selling price for the remainder of the year.

[6] Less tha ½ unit.

[7] Excludes shipments from Nye Metals, Inc., included with "Value of items that cannot be disclosed."

[8] Final figure, supersedes figure given in commodity section volume I–II.

[9] Excludes salt in brine, included with "Value of items that cannot be disclosed."

[10] Recoverable zinc valued at the yearly average price of Prime Western slab zinc, East St. Louis market. Represents value established after transportation, smelting and manufacturing charges have been added to the value of ore at mine.

Table 6.—Mineral production [1] in the Canal Zone and islands administered by the United States [2]

Mineral	1965		1966		1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
American Samoa:								
Pumice ... thousand short tons	---------	---------	17	$22	28	$24	21	$51
Sand and gravel ... do	60	$55	20	18	7	7	20	19
Stone ... do	60	60	12	12	28	50	53	79
Total	XX	115	XX	52	XX	81	XX	149
Canal Zone:								
Sand and gravel ... thousand short tons	83	85	72	91	56	94	55	77
Stone (crushed) ... do	153	366	114	267	100	245	106	290
Total	XX	451	XX	358	XX	339	XX	367
Guam: Stone ... thousand short tons	483	925	900	1,396	511	820	560	998
Virgin Islands: Stone (crushed) ... do	68	302	88	303	183	851	366	1,555
Wake: Stone (crushed) ... do	1	4	11	66	31	150	41	132

XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Production data for Wake furnished by U.S. Department of Transportation, Federal Aviation Administration; Guam, by the Government of Guam: American Samoa, by the Government of American Samoa.

Table 7.—Mineral production [1] in the Commonwealth of Puerto Rico

Mineral	1965		1966		1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement ... thousand 376-pound barrels	7,284	$23,415	7,603	$24,277	8,447	$27,397	8,923	$27,577
Clays ... thousand short tons	357	288	350	271	291	244	512	481
Lime ... do	27	867	30	960	35	1,106	39	1,187
Salt ... do	8	138	11	183	12	195	32	395
Sand and gravel ... do	8,147	12,405	9,879	14,554	14,101	21,633	16,146	24,723
Stone ... do	5,344	9,111	5,732	10,541	7,269	12,795	7,367	13,580
Total	XX	46,224	XX	50,786	XX	63,370	XX	67,943

XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 8.—U.S. exports of principal minerals and products

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals:				
Aluminum:				
Ingots, slabs, crude ... short tons	209,009	$99,961	180,279	$85,855
Scrap ... do	54,531	17,686	49,427	16,017
Plates, sheets, bars, etc ... do	96,275	70,757	114,062	77,418
Castings and forgings ... do	2,816	11,173	3,527	10,104
Antimony: Metals and alloys, crude ... short tons	82	75	109	54
Bauxite, including bauxite concentrates thousand long tons	2	218	7	360
Aluminum sulfate ... short tons	16,173	531	18,252	571
Other aluminum compounds ... do	578,627	51,075	915,581	74,527
Beryllium ... pounds	76,117	530	93,475	622
Bismuth: Metals and alloys ... do	152,684	395,695	120,466	292,245
Cadmium ... thousand pounds	691	1,669	530	1,400
Chrome:				
Ore and concentrates:				
Exports ... thousand short tons	8	328	13	517
Reexports ... do	157	5,422	126	5,351
Chromic acid ... do	1	392	1	675
Ferrochrome ... do	18	3,479	27	5,735
Cobalt ... thousand pounds	1,498	2,367	2,539	4,348
Columbium metals, alloys and other forms thousand pounds	6	341	8	291
Copper:				
Ore, concentrate, composition metal and unrefined (copper content) ... short tons	59,692	32,951	80,739	58,481
Refined copper and semimanufactures ... do	[r] 200,084	[r] 213,644	297,992	308,098
Other copper manufactures ... do	6,570	7,472	4,669	5,681
Copper sulfate or blue vitriol ... short tons	979	776	927	718
Copper base alloys ... do	78,213	75,809	98,534	98,322
Ferroalloys:				
Ferrosilicon ... do	11,774	3,228	18,372	4,481
Ferrophosphorous ... do	22,901	847	36,708	930
Gold:				
Ore and base bullion ... troy ounces	112,578	3,940	181,385	6,765
Bullion, refined ... do	28,607,404	1,001,259	23,781,006	832,394
Iron ore ... thousand long tons	[r] 5,906	71,585	5,884	70,835
Iron and steel:				
Pig iron ... short tons	7,451	319	10,941	657
Iron and steel products (major):				
Semimanufactures ... do	[r] 1,375,920	[r] 288,709	1,759,527	307,885
Manufactured steel mill products ... do	[r] 521,777	[r] 266,607	700,215	293,775
Iron and steel scrap: Ferrous scrap, including rerolling materials ... short tons	[r] 7,668,814	251,236	6,692,058	202,849
Lead:				
Pigs, bars, anodes ... do	6,536	4,767	8,281	4,740
Scrap ... do	394	198	937	219
Magnesium:				
Metal and alloys and semimanufactured forms, n.e.c ... short tons	13,173	9,115	19,457	13,049
Manganese:				
Ore and concentrate ... do	15,375	1,502	18,500	2,042
Ferromanganese ... do	1,861	760	3,710	645
Mercury:				
Exports ... 76-pound flasks	2,627	1,281	7,496	3,951
Reexports ... do	475	193	103	54
Molybdenum:				
Ore and concentrates (molybdenum content) thousand pounds	30,000	51,434	29,006	48,070
Metals and alloys, crude and scrap ... do	50	131	293	217
Wire ... do	34	661	26	551
Semifabricated forms, n.e.c ... do	292	702	118	487
Powder ... do	241	434	53	170
Ferromolybdenum ... do	1,533	2,436	863	1,194
Nickel:				
Alloys and scrap (including Monel metal), ingots, bars, sheets, etc ... short tons	26,169	53,225	28,555	56,386
Catalysts ... do	3,441	9,387	3,340	7,299
Nickel-chrome electric resistance wire ... do	565	2,530	624	2,652
Semifabricated forms, n.e.c ... do	1,362	5,587	1,162	5,336
Platinum:				
Ore, concentrate, metal and alloys in ingots, bars, sheets, anodes, and other forms, including scrap ... troy ounces	161,585	19,248	222,998	30,997

See footnotes at end of table.

Table 8.—U.S. exports of principal minerals and products—Continued

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals—Continued				
Platinum—Continued				
Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium (metal and alloys including scrap) ... troy ounces	[r] 118,267	[r] 9,772	172,159	18,522
Platinum group manufactures, except jewelry	NA	2,378	NA	2,493
Rare earths:				
Cerium ore, metal, alloys and lighter flints ... pounds	141,338	303	89,858	303
Silver:				
Ore and base bullion ... thousand troy ounces	2,365	4,242	23,129	47,549
Bullion, refined ... do	68,404	91,718	102,632	199,551
Tantalum:				
Ore, metal, and other forms ... thousand pounds	134	1,724	171	1,899
Powder ... do	[r] 51	[r] 1,599	84	2,668
Tin:				
Ingots, pigs, bars, etc:				
Exports ... long tons	2,050	6,962	3,813	12,734
Reexports ... do	429	1,412	682	2,267
Tin scrap and other tin-bearing material except tinplate scrap ... long tons	2,957	1,490	5,128	2,676
Titanium:				
Ore and concentrate ... short tons	3,027	167	4,238	276
Sponge (including iodide titanium and scrap) ... short tons	1,429	1,703	2,756	1,748
Intermediate mill shapes and mill products, n.e.c ... short tons	[r] 1,812	[r] 13,366	1,228	7,575
Dioxide and pigments ... do	25,852	7,165	30,188	8,227
Tungsten: Ore and concentrates:				
Exports ... do	944	[r] 2,934	604	1,705
Reexports ... do	269	576	56	117
Vanadium ore and concentrate, pentoxide, etc. (vanadium content) ... thousand pounds	1,575	4,043	925	1,972
Zinc:				
Slabs, pigs, or blocks ... short tons	16,809	4,287	33,011	9,797
Sheets, plates, strips, or other forms, n.e.c. ... short tons	3,565	2,709	3,048	2,228
Scrap (zinc content) ... do	1,665	530	2,298	886
Semifabricated forms, n.e.c ... do	2,161	1,177	15,000	3,840
Zirconium:				
Ore and concentrate ... do	2,729	360	2,026	361
Metals and alloys and other forms ... pounds	637,612	6,909	693,927	8,709
Nonmetals:				
Abrasives:				
Dust and powder of precious or semiprecious stones, including diamond dust and powder ... thousand carats	4,317	12,526	6,015	16,616
Crushing bort ... do	18	210	26	168
Industrial diamonds ... do	148	924	300	1,153
Diamond grinding wheels ... do	429	2,946	594	3,010
Other natural and artificial, metallic abrasives and products	NA	34,290	NA	39,319
Asbestos: Unmanufactured:				
Exports ... short tons	47,356	5,951	41,217	4,677
Reexports ... do	362	74	19	2
Boron: Boric acid, borates, crude and refined ... short tons	186,482	18,710	206,823	20,347
Cement ... thousand 376-pound barrels	980	4,452	942	3,884
Clays:				
Kaolin or china clay ... short tons	321,929	9,921	889,882	12,995
Fire clay ... do	176,367	2,789	151,940	2,672
Other clays ... do	651,366	19,853	977,804	28,575
Fluorspar ... do	10,345	517	12,614	496
Graphite ... do	3,569	460	4,169	509
Gypsum:				
Crude, crushed or calcined ... thousand short tons	39	1,707	39	1,688
Manufactures, n.e.c	NA	1,211	NA	1,868
Kyanite and related minerals ... short tons	21,428	1,408	20,477	1,311
Lime ... do	52,143	1,099	68,915	1,437
Mica sheet, waste and scrap and ground ... pounds	14,301,524	781	27,014,321	1,408
Manufactured ... do	526,690	1,753	474,509	1,358

See footnotes at end of table.

Table 8.—U.S. exports of principal minerals and products—Continued

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Nonmetals—Continued				
Mineral-earth pigments: iron oxide, natural and manufactured ... short tons	3,123	$1,312	3,321	$1,257
Nitrogen compounds (major) thousand short tons	2,911	165,008	4,042	186,472
Phosphate rock ... do	10,282	94,413	12,083	104,559
Phosphatic fertilizers (superphosphates) ... do	743	35,139	1,289	56,359
Pigments and compounds (lead and zinc):				
Lead pigments ... short tons	1,909	772	1,877	770
Zinc pigments ... do	4,175	1,331	4,940	1,483
Potash:				
Fertilizer ... do	1,146,131	35,010	1,339,491	39,610
Chemical ... do	29,060	4,886	33,397	5,114
Quartz, natural, quartzite, cryolite and chiolite short tons	1,228	285	751	168
Salt:				
Crude and refined ... thousand short tons	678	4,583	728	4,650
Shipments to noncontiguous Territories thousand short tons	11	892	18	1,772
Sodium and sodium compounds:				
Sodium sulfate ... thousand short tons	28	856	56	1,844
Sodium carbonate ... do	304	9,914	288	9,131
Stone:				
Dolomite, block ... do	113	1,756	102	1,518
Limestone, crushed, ground, broken ... do	1,159	3,496	1,297	3,294
Marble and other building and monumental thousand cubic feet	NA	958	NA	849
Stone, crushed, ground, broken thousand short tons	306	3,743	292	3,278
Manufactures of stone	NA	1,203	NA	1,030
Sulfur:				
Crude ... thousand long tons	2,043	81,492	1,549	65,650
Crushed, ground, flowers of ... do	150	9,522	53	3,855
Talc, crude and ground ... short tons	66,195	3,450	65,648	3,521
Fuels:				
Carbon black ... thousand pounds	[r] 236,035	[r] 24,410	263,122	28,626
Coal:				
Anthracite ... thousand short tons	595	7,622	518	6,553
Bituminous ... do	[r] 49,528	[r] 475,015	50,637	495,980
Briquets ... do	120	2,293	65	2,698
Coke ... do	710	16,492	792	18,613
Petroleum:				
Crude ... thousand barrels	[r] 26,541	[r] 86,387	1,803	4,452
Gasoline ... do	[r] 3,602	19,106	2,061	12,390
Jet ... do	[r] 283	1,142	258	1,025
Naphtha ... do	[r] 2,299	21,999	2,550	26,421
Kerosine ... do	158	1,252	431	3,644
Distillate oil ... do	[r] 6,041	[r] 16,304	1,866	8,311
Residual oil ... do	[r] 22,150	43,793	20,013	40,746
Lubricating oil ... do	[r] 17,771	[r] 208,620	17,666	203,807
Asphalt ... do	[r] 348	3,167	354	3,059
Liquefied petroleum gases ... do	[r] 9,256	32,182	10,599	32,487
Wax ... do	[r] 1,676	34,077	1,588	31,934
Coke ... do	[r] 16,279	55,187	19,508	68,068
Petrochemical feedstocks ... do	[r] 2,983	15,344	2,781	15,338
Miscellaneous ... do	[r] 893	[r] 19,455	1,040	21,575
Total	XX	4,876,648	XX	4,949,527

[r] Revised. XX Not applicable.
NA Not available.

Table 9.—U.S. imports for consumption of principal minerals and products

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals:				
Aluminum:				
Metal ... short tons	449,716	$194,995	685,699	$298,759
Scrap ... do	30,489	10,040	37,521	12,134
Plates, sheets, bars, etc ... do	58,341	40,243	62,135	41,816
Antimony:				
Ore (antimony content) ... do	10,517	4,090	10,614	4,145
Needle or liquated ... do	29	18	60	42
Metal ... do	2,654	1,849	2,693	2,037
Oxide ... do	5,098	3,762	4,801	3,540
Arsenic: White (As_2O_3 content) ... do	27,075	2,503	25,195	2,626
Bauxite: Crude ... thousand long tons	[r] 11,594	151,418	10,976	140,228
Beryllium ore ... short tons	9,511	3,167	3,822	1,418
Bismuth (general imports) ... pounds	1,379,729	5,172	1,265,671	4,718
Boron carbide ... do	214,620	469	227,486	575
Cadmium:				
Metal ... thousand pounds	1,587	3,817	1,927	4,602
Flue dust (cadmium content) ... do	1,166	1,093	1,605	1,796
Calcium:				
Metal ... pounds	423,631	370	137,251	120
Chloride ... short tons	4,385	158	14,069	528
Chromite:				
Ore and concentrates (Cr_2O_3 content) thousand short tons	568	21,854	499	18,189
Ferrochrome (chromium content) ... do	39	13,758	41	14,197
Metal ... do	1	1,842	1	2,053
Cobalt:				
Metal ... thousand pounds	7,946	14,420	9,219	16,285
Oxide (gross weight) ... do	1,044	1,670	1,186	2,113
Salts and compounds (gross weight) ... do	167	200	107	90
Columbium ore ... do	7,431	5,266	3,657	2,848
Copper: (copper content)				
Ore and concentrates ... short tons	35,673	28,820	71,884	66,291
Regulus, black, coarse ... do	2	35	8	4
Unrefined, black, blister ... do	[r] 270,728	[r] 217,473	274,180	224,013
Refined in ingots, etc ... do	[r] 332,290	[r] 311,415	403,630	438,608
Old and scrap ... do	[r] 16,717	[r] 14,802	11,571	12,117
Old and clippings ... do	2,549	2,479	2,131	2,042
Ferroalloys: Ferrosilicon (silicon content) short tons	15,337	4,456	10,612	3,207
Gold:				
Ore and base bullion ... troy ounces	219,382	7,671	213,662	7,855
Bullion ... do	710,487	24,876	5,730,853	218,408
Iron ore ... thousand long tons	[r] 44,611	[r] 443,918	43,941	453,753
Iron and steel:				
Pig iron ... short tons	605,234	27,599	785,899	30,486
Iron and steel products (major):				
Iron products ... short tons	[r] 27,614	[r] 6,450	39,542	9,606
Steel products ... do	[r] 11,457,973	[r] 1,319,830	17,853,995	1,989,482
Scrap ... do	215,635	8,181	276,498	10,784
Tinplate ... do	13,527	381	17,727	541
Lead:				
Ore, flue dust, matte (lead content) short tons	144,156	29,111	96,863	18,990
Base bullion (lead content) ... do	677	1,224	63	648
Pigs and bars (lead content) ... do	363,596	88,697	337,620	81,264
Reclaimed, scrap, etc. (lead content) short tons	9,368	1,951	4,249	748
Sheets, pipe, and shot ... do	1,212	322	893	256
Babbitt metal and solder (lead content) short tons	413	1,423	566	2,244
Manufactures ... do	1,363	524	893	256
Magnesium:				
Metallic and scrap ... do	[r] 9,235	[r] 4,920	4,086	2,219
Alloys (magnesium content) ... do	354	1,529	705	1,129
Sheets, tubing, ribbons, wire and other forms (magnesium content) ... short tons	[r] 132	[r] 422	25	416
Manganese:				
Ore (35 percent or more manganese) (manganese content) ... short tons	[r] 975,760	[r] 55,710	870,390	45,264
Ferromanganese (manganese content) ... do	[r] 167,612	[r] 26,437	160,694	21,430

See footnotes at end of table.

Table 9.—U.S. imports for consumption of principal minerals and products—Continued

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals—Continued				
Mercury:				
Compounds...pounds	14,011	$14	33,473	$47
Metal...76-pound flasks	24,348	[r] 10,553	23,246	11,164
Minor metals: Selenium and salts...pounds	300,638	1,545	582,535	3,076
Nickel:				
Pigs, ingots, shot, cathodes...short tons	113,860	193,848	108,158	201,312
Scrap...do	1,104	1,240	1,969	2,564
Oxide...do	6,208	8,130	6,388	8,911
Platinum group:				
Unrefined materials:				
Grains and nuggets, including crude dust and residues...troy ounces	41,798	5,195	64,777	10,180
Sweeping, waste and scrap...do	102,067	6,880	54,831	3,861
Osmiridium...do	4,179	458	11,736	2,109
Refined metal:				
Platinum...do	322,764	38,282	383,366	45,535
Palladium...do	737,082	[r] 27,503	1,165,511	50,834
Iridium...do	8,874	1,505	5,503	1,018
Osmium...do	[r] 481	[r] 170	272	54
Rhodium...do	47,689	10,079	71,016	10,360
Ruthenium...do	56,563	2,049	11,162	454
Radium:				
Radioactive substitutes...	NA	3,000	NA	3,241
Rare earths: Ferrocerium and other cerium alloys pounds	[r] 7,241	[r] 35	23,003	77
Silver:				
Ore and base bullion...thousand troy ounces	25,642	33,437	28,786	49,587
Bullion...do	29,878	43,650	41,923	88,213
Tantalum: Ore...thousand pounds	[r] 1,730	[r] 5,518	1,230	4,164
Tin:				
Ore (tin content)...long tons	3,255	7,635	2,282	5,287
Blocks, pigs, grains, etc...do	50,223	166,529	57,358	181,940
Dross, skimmings, scrap, residues and tin alloys, n.s.p.f...long tons	449	462	487	532
Tin foil, powder, flitters, etc...	NA	[r] 355	NA	2,742
Titanium:				
Ilmenite...short tons	207,906	5,145	246,109	5,167
Rutile...do	167,100	[r] 11,943	174,366	12,653
Metal...pounds	14,950,359	14,415	7,610,236	8,148
Ferrotitanium...do	306,317	85	398,923	143
Compounds and mixtures...do	96,251,565	16,726	111,080,983	19,618
Tungsten: (tungsten content)				
Ore and concentrate...thousand pounds	1,699	3,784	1,743	3,272
Metal...do	129	524	33	356
Other alloys...pounds	[r] 10,773	65	22,951	120
Zinc:				
Ore (zinc content)...short tons	431,319	58,075	451,787	68,466
Blocks, pigs, and slabs...do	222,002	57,531	306,651	76,035
Sheets...do	648	276	754	290
Old, dross, and skimmings...do	3,963	673	1,459	182
Dust...do	3,771	1,211	8,100	2,443
Manufactures...	NA	318	NA	447
Zirconium: Ore, including zirconium sand short tons	59,303	1,891	59,900	2,014
Nonmetals:				
Abrasives: Diamonds (industrial) thousand carats	[r] 17,112	[r] 63,576	13,676	60,277
Asbestos...short tons	645,112	65,743	737,909	72,930
Barite:				
Crude and ground...do	532,314	4,659	662,705	5,666
Witherite...do	1,260	53	2,029	59
Chemicals...do	5,243	682	5,977	843
Cement...thousand 376-pound barrels	5,913	14,698	7,370	17,511
Clays:				
Raw...short tons	103,404	2,039	91,205	1,709
Manufactured...do	5,382	252	6,177	242
Cryolite...do	36,319	4,118	33,772	5,455
Feldspar: Crude...long tons	280	8	----------	----------
Fluorspar...short tons	911,870	24,485	1,050,107	28,699
Gem stones:				
Diamonds...thousand carats	3,961	387,472	4,348	475,131
Emeralds...do	242	5,518	365	10,644
Other...	NA	46,655	NA	51,418
Graphite...short tons	56,675	2,348	67,922	2,494

See footnotes at end of table.

Table 9.—U.S. imports for consumption of principal minerals and products—Continued

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Nonmetals—Continued				
Gypsum:				
Crude, ground, calcined thousand short tons	[r]4,565	$9,809	5,476	$11,473
Manufactures	NA	1,544	NA	1,585
Iodine, crude thousand pounds	3,459	3,177	5,883	5,594
Kyanite short tons	1,821	75	1,450	51
Lime:				
Hydrated do	545	12	873	21
Other do	79,983	961	71,632	877
Dead-burned dolomite [1] do	42,413	1,832	33,498	1,552
Magnesium:				
Magnesite do	127,955	7,612	131,640	8,489
Compounds do	[r]37,043	[r]816	49,344	1,326
Mica:				
Uncut sheet and punch thousand pounds	1,733	1,990	1,491	1,539
Scrap do	1,016	25	3,217	77
Manufactures do	5,440	3,373	5,293	3,373
Mineral-earth pigments: Iron oxide pigments:				
Natural short tons	3,670	271	4,442	253
Synthetic do	14,034	2,626	18,596	3,455
Ocher, crude and refined do	236	16	126	8
Siennas, crude and refined do	951	104	1,464	173
Umber, crude and refined do	4,275	162	4,671	178
Vandyke do	272	24	589	50
Nitrogen compounds (major), including urea thousand short tons	[r]1,692	[r]84,080	1,652	82,221
Phosphate, crude do	139	3,261	116	2,679
Phosphatic fertilizers do	105	6,167	44	2,222
Pigments and salts:				
Lead pigments and compounds short tons	[r]30,669	[r]6,576	32,004	6,950
Zinc pigments and compounds do	18,988	3,404	20,838	4,152
Potash do	[r]2,929,050	[r]73,649	3,671,973	78,573
Pumice:				
Crude or unmanufactured do	5,702	49	9,436	69
Wholly or partly manufactured do	240,273	580	302,240	736
Manufactures, n.s.p.f	NA	22	NA	17
Quartz crystal (Brazilian pebble) pounds	1,049,544	730	1,180,153	607
Salt thousand short tons	2,843	8,541	3,456	11,487
Sand and gravel:				
Glass sand do	44	159	25	144
Other sand and gravel do	588	753	729	984
Sodium sulfate do	[r]289	[r]4,508	305	5,108
Stone and whiting	NA	19,823	NA	24,628
Strontium: Mineral short tons	5,612	118	12,896	290
Sulfur and pyrites:				
Sulfur:				
Ores and other forms, n.e.s. thousand long tons	1,474	47,612	1,572	64,277
Pyrites do	10	51	13	68
Talc: Unmanufactured short tons	15,361	653	24,313	973
Fuels:				
Carbon black:				
Acetylene pounds	5,784,814	987	5,343,923	915
Gas black and carbon black do	330,910	56	2,351,312	173
Coal:				
Bituminous, slack, culm and lignite short tons	227,338	1,992	224,394	1,900
Briquets do	17,422	260	2,891	44
Coke do	92,001	1,704	94,085	1,904
Peat:				
Fertilizer grade do	277,241	12,088	285,875	12,716
Poultry and stable grade do	3,601	189	1,725	100
Petroleum:				
Crude oil thousand barrels	411,649	930,327	472,323	1,067,450
Gasoline do	15,215	51,883	21,591	81,614
Special naphtha do	375	780	1,399	3,442
Kerosine do	33	93	190	568
Distillate fuel oil do	18,492	50,483	36,558	103,094
Residual fuel oil do	395,939	941,895	421,561	830,475
Military jet fuel do	5,450	16,132	7,117	21,066
Commercial jet fuel do	26,941	80,015	30,375	90,214
Liquefied gases do	9,885	16,805	11,647	19,916
Asphalt do	6,447	13,152	6,236	13,096
Unfinished oil do	35,225	93,699	29,350	71,321
Lubricants do	40	501	33	533
Wax do	20	176	17	74
Petrochemical feed stocks do	280	2,990	----------	----------
Total	XX	6,987,242	XX	8,483,473

[r] Revised. XX Not applicable.
NA Not available.

[1] Dead-burned basic refractory material consisting chiefly of magnesia and lime.

Table 10.—Comparison of world[1] and United States production of principal metals and minerals

Mineral	1967			1968 [p]		
	World [r] [1]	United States		World [1]	United States	
	Thousand short tons (unless otherwise stated)		Percent of world	Thousand short tons (unless otherwise stated)		Percent of world
Fuels:						
Carbon black ... thousand pounds	4,447,583	2,483,840	56	5,041,488	2,811,806	56
Coal:						
Bituminous	2,003,150	548,136	27	2,073,304	540,428	26
Lignite	792,472	4,490	(2)	812,799	4,817	(2)
Pennsylvania anthracite	200,736	12,255	6	200,835	11,461	6
Coke (excluding breeze):						
Gashouse [3]	20,472	163	1	15,585	174	1
Oven and beehive	334,522	[r] 64,580	20	315,272	63,653	20
Natural gas (marketable) ... million cubic feet	28,408,525	18,171,325	64	31,028,664	19,322,400	62
Peat	218,576	617	(2)	211,222	619	(2)
Petroleum (crude) ... thousand barrels	12,873,486	3,215,742	25	14,083,717	3,329,042	24
Nonmetals:						
Asbestos	[r] 3,095	123	4	NA	121	NA
Barite	[r] 3,820	944	25	3,915	[4] 927	24
Cement [5] ... thousand 376-pound barrels	2,722,068	385,629	14	2,872,929	397,348	14
China clay	11,706	[6] 3,973	34	NA	[6] 4,201	NA
Corundum	11	---	---	NA	---	---
Diamonds ... thousand carats	[r] 9,634	---	---	10,600	---	---
Diatomite	1,711	[7] 627	37	1,522	[7] 627	41
Feldspar ... thousand long tons	[r] 1,974	615	31	NA	668	NA
Fluorspar	3,502	296	8	NA	252	NA
Graphite	396	W	NA	392	W	NA
Gypsum	52,145	9,393	18	NA	10,018	NA
Lime (sold or used by producers)	88,828	17,974	20	80,818	18,637	23
Magnesite	[r] 11,399	W	NA	11,145	W	NA
Mica (including scrap) ... thousand pounds	[r] 317,097	237,026	75	337,524	250,661	74
Nitrogen, agricultural [5] [8]	24,442	6,237	26	27,813	6,872	25
Phosphate rock ... thousand long tons	86,133	39,770	46	92,838	41,251	44
Potash (K_2O equivalent)	16,858	3,299	20	17,140	2,722	16
Pumice [9]	15,728	3,474	22	NA	3,551	NA
Pyrites ... thousand long tons	21,856	861	4	21,737	872	4
Salt [5]	131,564	27,285	21	124,442	28,813	23
Strontium [9]	14	---	---	20	---	---
Sulfur, elemental ... thousand long tons	17,597	8,270	47	18,604	8,814	47
Talc, pyrophyllite, and soapstone	[r] 4,352	903	21	4,738	958	20
Vermiculite [9]	370	255	69	417	290	70
Metals, mine basis:						
Antimony (content of ore and concentrate) ... short tons	63,849	892	1	67,767	856	1
Arsenic, white [9]	65	W	NA	65	W	NA
Bauxite ... thousand long tons	[r] 43,889	[10] 1,654	4	42,880	[10] 1,665	4
Beryllium concentrate ... short tons	[r] 5,423	W	NA	6,116	168	3
Bismuth ... thousand pounds	7,630	W	NA	7,589	W	NA
Cadmium ... do	28,279	[11] 8,699	31	31,032	[11] 10,651	34

Chromite	4,720	----------	--------	5,206	----------	--------
Cobalt (contained)......short tons	22	W	NA	22	W	NA
Columbium-tantalum concentrates [9]......thousand pounds	21,052	W	NA	20,331	W	NA
Copper (content of ore and concentrate)	5,519	[12] 954	17	5,894	[12] 1,205	20
Gold......thousand troy ounces	45,708	1,584	3	46,168	1,478	3
Iron ore......thousand long tons	[r] 615,538	[13] 84,179	14	670,943	[13] 85,865	13
Lead (content of ore and concentrate)	3,169	[12] 317	10	3,309	[12] 359	11
Manganese ore (35 percent or more Mn)	18,375	13	(2)	19,194	11	(2)
Mercury......thousand 76-pound flasks	[r] 233	24	10	255	29	11
Molybdenum (content of ore and concentrate)......thousand pounds	[r] 126,416	[r] 90,097	71	[e] 125,673	93,477	74
Nickel (content of ore and concentrate)	486	15	3	529	15	3
Platinum groups (Pt., Pd., etc.)......thousand troy ounces	3,170	16	1	3,415	15	(2)
Silver......do	259,006	32,119	12	272,507	32,729	12
Tin (content of ore and concentrate)......long tons	215,006	W	NA	226,624	W	NA
Titanium concentrates:						
Ilmenite [9]	[r] 3,019	935	31	3,216	979	30
Rutile [9]	[r] 337	W	NA	357	W	NA
Tungsten concentrate (contained tungsten)......short tons	31,496	4,322	14	34,907	5,094	15
Vanadium (content of ore and concentrate)[9]......do	[r] 10,509	4,963	47	12,562	6,483	52
Zinc (content of ore and concentrate)	5,331	549	10	5,436	529	10
Metals, smelter basis:						
Aluminum	8,352	3,269	39	8,864	3,255	37
Copper	5,939	[14] 862	15	6,649	[14] 1,266	19
Iron, pig (including ferroalloys)	392,317	89,479	23	391,451	91,345	23
Lead	3,058	[15] 380	12	3,221	[15] 467	14
Magnesium......short tons	205,069	97,406	47	207,089	98,375	48
Selenium [9]......thousand pounds	[r] 2,118	598	28	2,045	633	31
Steel ingots and castings	542,524	[16] 127,213	23	564,545	[16] 131,462	23
Tellurium [9]......thousand pounds	284	135	48	270	121	45
Tin......long tons	219,276	[17] [18] 3,048	1	230,021	[17] [18] 3,453	2
Uranium oxide (U_3O_8)[9]......short tons	18,978	9,125	48	22,344	12,338	55
Zinc	4,550	939	21	5,017	1,021	20

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[e] Estimate. [p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data.

[1] Total is not strictly comparable with previous years as it does not represent total world production. Confidential U.S. data are excluded. The data includes reported figures and reasonable estimates in some instances where data were not available no reasonable estimate could be made and none has been included except for gold, silver and pyrites.

[2] Less than ½ unit.

[3] Includes low- and medium-temperature and gashouse coke.

[4] Sold or used by producers.

[5] Including Puerto Rico.

[6] Kaolin sold or used by producers.

[7] Average annual production from the appropriate 3-year totals, 1963–65 and 1966–68.

[8] Year ended June 30 of year stated (United Nations).

[9] World total exclusive of U.S.S.R.

[10] Dry bauxite equivalent of crude ore.

[11] Including secondary.

[12] Recoverable.

[13] Iron-nickel ore.

[14] Smelter output from domestic and foreign ores, exclusive of scrap. Production from domestic ores only, exclusive of scrap, was as follows: 1964, 1,301,107; 1965, 1,402,798; 1966, 1,429,854; 1967, 941,343; and 1968, 1,233,951.

[15] Lead refined from domestic and foreign ores, excludes lead refined from imported base bullion.

[16] Data from American Iron and Steel Institute. Excludes production of castings by companies that do not produce steel ingots.

[17] U.S. imports of tin concentrates (tin content).

[18] Includes tin content of alloys made directly from ores.

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Injury Experience and Worktime in the Mineral Industries by States

By Forrest T. Moyer[1]

Injury experience in the mineral mining and processing industries during 1968 was slightly improved in the nonfatal-injury record but worse in the fatality record. The resulting frequency rate of all injuries was slightly better, whereas the injury-severity rate retrogressed appreciably from the figure for 1967. Overall operating activity, as measured by man-hours of worktime, was slightly higher in 1968. However, there were several major segments of the mineral industries in which activity was lower owing to reduced demand for mineral products and to several major work stoppages.

These statistics comprise the injury and work experience of all personnel engaged in production, exploration, development, maintenance, repair, and force-account construction work, including supervisory and technical personnel, and working partners and owners at mineral-producing and mineral-processing establishments in the United States. Data concerning officeworkers are excluded except for the oil and gas industry for which such information is not separable. All injury rates and totals are calculated from data before rounding. The data for 1968 are preliminary except for the anthracite, coke, petroleum and natural gas, native asphalt, peat, and slag industries, which are final. The figures represent full coverage for all industries except oil and gas for which coverage is not complete, particularly with respect to small companies.

Injury and worktime data were collected from coal producers as required by the Federal Coal Mine Safety Act as Amended (30 U.S. Code, secs. 455–482, Supp. III (1968)). Similar information was collected as required by the Federal Metal and Nonmetallic Mine Safety Act (30 U.S. Code, secs. 721–740, Supp. III (1968)) from metal, nonmetal, stone, and sand and gravel producers. Mineral and mineral fuel producers and processors, not covered under either of the acts, voluntarily reported the requested injury and worktime data.

Information on the major mineral-industry segments in this chapter are broken down to specific component industries in a companion chapter in Volume I–II of the Minerals Yearbook.

Injury Experience.—The overall rate of occurrence of 16.62 disabling work injuries per million man-hours for all mineral industries in 1968 comprised frequencies of 0.32 for fatal and 16.30 for nonfatal injuries. The fatality rate worsened by 19 percent from that of 0.27 in 1967. For nonfatal injuries, the rate of occurrence was improved by 3 percent from the corresponding rate of 16.83 in 1967.

The injury-severity rate of 2,677 days lost per million man-hours of worktime for all mineral industries was a regression of 8 percent from that of 2,468 in 1967. The total of 606 work fatalities in 1968 was 94 higher than in the preceding year owing largely to three major disasters (a single accident which results in the death of five men or more) in mining activities. On March 5, 1968, a shaft fire at the Belle Isle Salt Mine, Cargill Incorporated, Belle Isle, La., caused the death of 21 men in the underground workings. On August 7, a dust explosion, initiated by improper handling of explosives in the underground workings of the River Queen No. 1 mine, Peabody Coal Company, Greenville, Ky., claimed the lives of nine men. On November 20, a gas and dust explosion in the

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[1] Chief, Office of Accident Analysis.

Consol No. 9 Mine, Mountaineer Coal Company Division of Consolidation Coal Company, Farmington, W. Va., caused 78 deaths. There were no major disasters in the mineral industries in 1967.

Nonfatal injuries for all mineral mining and processing industries totaled 31,060 in 1968 or 300 less than in the preceding year. This lower number of injuries, coupled with the increased worktime, resulted in the improved frequency rate for nonfatal injuries in 1968.

The safety records of the major segments of the mineral industries displayed varying trends in 1968, as shown in the summary section at the end of table 1. All general measures of injury experience (number of injuries, frequency rate, and severity rate) in the metal mining and milling industry were improved appreciably over 1967 levels. There were similar improvements in the safety records of the peat and the native asphalt industries. In the coal industry, both the number of fatalities and the severity rate worsened markedly, but the overall injury-frequency rate was improved owing to the lower total of nonfatal injuries in 1968. The numbers of fatal and nonfatal injuries and the injury-severity rate for the oil and natural gas industries were less favorable, but rate of occurrence for all injuries was slightly better than in 1967 because of the increased worktime. In the nonmetal mining and processing industry, the number of fatalities and the severity rate of injuries retrogressed sharply and the injury-frequency rate was slightly higher than in 1967. There were fewer fatal but more nonfatal injuries in the sand and gravel industry during 1968 and as a result the injury-frequency rate was less favorable but the severity rate was improved. The number of fatalities and the injury-severity rate for the stone quarrying industry worsened appreciably in 1968, and the frequency rate remained at the same level as in 1967. In primary nonferrous smelters and refineries, the injury-severity rate was improved appreciably owing to the reduced number of fatalities, but the overall frequency rate worsened because of the marked increase in nonfatal injuries over 1967 levels. The safety record at coke plants was improved in both the number of injuries and the frequency rate, but the injury-severity rate was less favorable than in 1967. At slag plants in 1968, fatality experience and the injury-severity rate were impoved sharply, but the injury-frequency rate was slightly lower than in 1967.

Worktime.—Operating activity in 1968, in terms of man-hours worked, was higher than in 1967 in the oil and gas, metal, stone, primary nonferrous smelters and refineries, blast-furnace slag, peat, and native asphalt industries. The greater activity in these industries more than offset lessened activity in the other mineral industry groups. As a result, total worktime of 1,905 million man-hours in 1968 was 2 percent higher than that of 1,863 million man-hours in 1967.

STATE DATA

Injury and worktime data by States are presented for the mineral-extractive and processing industries. The breakdown by States is not shown for the purely processing industries—coke, primary nonferrous smelting and refining, and blast-furnace slag—nor for oil and natural gas, but totals for these industries are included in the summarization at the end of the State table (table 1).

The mineral industries of West Virginia, in which underground coal mining was dominant, had the highest injury-frequency rate of these industries in any State in 1968. The rate of 52.40 injuries per million man-hours represented an improvement over that of 54.47 in 1967. Mineral mines and mills in Idaho, where the metal industries predominate, ranked second highest in injury-frequency with a rate of 46.42 in 1968, a regression from that of 41.96 in 1967. In Kentucky, the mineral industries in 1968 had a frequency rate of 42.96 injuries per million man-hours, the third highest of any State.

Mineral mines and mills in West Virginia in 1968 had a higher injury-severity rate, 14,533 days lost per million man-hours, than these industries in any other State. The next highest injury-severity rates were for the mineral industries in Louisiana (14,367), and in Kentucky (11,623).

The mineral industries of West Virginia had the largest number of work fatalities, 153 in 1968. This total was far above that of 63 in 1967, owing principally to the 78 deaths in a coal-mine explosion in November. States ranking next in number of mineral industry fatalities during 1968 were Kentucky (66), Pennsylvania (39), Louisiana (25), and Ohio (23). States ranked by number of nonfatal injuries in mines and processing plants during 1968 were West Virginia (3,932), Pennsylvania (1,869), Kentucky (1,683), Virginia (1,147), and Illinois (1,042).

Of the States with major mineral industry activity (more than 10 million man-hours of worktime) in 1968, mines and plants had the lowest injury-frequency rates in Minnesota (7.44), Alabama (11.89), and Florida (12.66). Similarly, the most favorable injury-severity rates were for the mineral industries in Michigan (1,331), Georgia (1,379), and New York (1,438).

The magnitude of mining and milling activity in the ranking States, as gaged by worktime in thousands of man-hours, was as follows: Pennsylvania (78,115), West Virginia (78,003), Kentucky (40,708), California (37,728), and Ohio (36,748). States with the largest number of man-hours worked (in thousands) within the general groupings of mining and milling industries were as follows: Coal—West Virginia (72,890), metal—Arizona (24,534), nonmetal—California (9,767), stone—Pennsylvania (18,370), and sand and gravel—California (11,465).

ACTIVE OPERATIONS

The number of active mineral-extractive and processing establishments in the United States during 1967 are shown in table 1 by States for each of the general groupings except for the oil and gas industries. Similar data for 1968 are not yet available.

Producers and processors of minerals reported 26,784 active mines, quarries, pits, dredges, brine, well, and other types of mineral-extractive operations in 1967. The largest numbers of mining establishments were in Pennsylvania (1,995), Kentucky (1,899), California (1,669), and West Virginia (1,665). Active mineral cleaning and processing plants totaled 5,469 in 1967.

WORK STOPPAGES

A total of 320 work stoppages in certain mineral industry groups during 1968 resulted in a time loss of slightly more than 3.5 million man-days of work, according to the Bureau of Labor Statistics, U.S. Department of Labor. Comparable data for 1967 were 292 work stoppages with an aggregate loss of slightly more than 4.6 million man-days.

As detailed in table 3, most of the large time loss in 1968 resulted from major stoppages concerning wage contract negotiations in the bituminous coal mining, copper mining, and primary nonferrous smelting and refining industries. In bituminous coal mining, the major stoppage occurred in the first half of October and lasted about a week although a number of operations were closed for a longer period. The extended major stoppages in the copper mining and primary copper smelting and refining industries had started about mid-July 1967 and were not ended for the greater part of these industries until near the end of March 1968. The total time lost from these continuous and related work stoppages is estimated at approximately 4 million man-days in copper mining and 2 million man-days in copper smelting and refining.

SAFETY COMPETITIONS

The Bureau of Mines conducts annual safety competitions among the Nation's mineral industries. These contests have been recognized as effective tools to promote accident-prevention work and to arouse and maintain the interest of employees in daily safe-working practices. A total of 1,502 mineral operations participated in these contests during 1968.

In 1968, a total of 988 mines, open pits, and quarries competed in the 44th National Safety Competition (the "Sentinels of Safety" contest) cosponsored by the Bureau of Mines and the American Mining Congress. A total of 446, or 45 percent, of the participants operated throughout 1968 without a disabling work injury. The aggregate worktime of these injury-free plants was 31.3 million man-hours or 20 percent of the total man-hours of exposure at all enrolled plants. The National Safety Competition is divided into six groups to assure equality of competition among operations with relatively similar working conditions. The winning operation in each group is awarded the "Sentinels of Safety" trophy and plant flag. In addition, each employee and official at the winning plant receives a personal "Certificate of Accomplishment in Safety" from the Bureau in recognition of his daily contribution to the winning plant record.

The following operations won the "Sentinels of Safety" trophies by working the largest number of injury-free man-hours throughout 1968 in each of the six competing groups:

Underground Nonmetal Mines.—Saunders mine, Duval Corporation, Carlsbad, N. Mex., 662,110 man-hours.

Underground Metal Mines.—Deremo mine, Nuclear Division, Union Carbide Corporation, Dove Creek, Colo., 319,883 man-hours.

Underground Coal Mines.—No. 2 mine, Gary District, United States Steel Corporation, Wilcoe, W. Va., 690,139 man-hours.

Surface Coal Mines.—Egypt Valley No. 21 mine, Hanna Coal Company Division, Consolidation Coal Company, Barnesville, Ohio, 341,364 man-hours.

Open-Pit Mines (Metal and Nonmetal).—Hoyt Lakes mine, Pickands Mather and Company, Hoyt Lakes, Minn., 1,591,967 man-hours.

Stone Quarries.—Millard quarry, Bethlehem Mines Corporation, Annville, Pa., 441,522 man-hours.

A total of 285 operations participated in the National Sand and Gravel Safety Competition sponsored by the Bureau. There were 170 injury-free plants, 60 percent of the total number enrolled in the 1968 contest. These plants were operated 5.0 million man-hours, or 39 percent of the total worktime of all participating operations.

The following operations won top safety honors for injury-free operation in 1968 in the bank or pit and the dredge groups into which the contest is divided:

Bank or Pit.—Springfield plant, Virginia Sand and Gravel Company, Springfield, Va., 193,338 man-hours.

Dredge.—Dover plant, T. L. Herbert and Sons, Linden, Tenn., 114,190 man-hours.

Three other annual safety competitions cosponsored with the Bureau by the National Lime Association, the National Limestone Institute, and the National Slag Association were conducted in 1968. A total of 229 plants were enrolled in these contests. A total of 110 plants, 48 percent of all participants, had no disabling work injuries throughout 1968. The injury-free plants were operated 7.3 million man-hours, or 41 percent of the total worktime at all enrolled operations.

Table 1.—Worktime and injury experience in the mineral industries (mines and mills) in the United States, by States[1]

State and industry group	Average men working daily		Man-days worked (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours				Count of operations 1967	
							Fatal		Nonfatal		Frequency		Severity			
	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	Mines	Mills
Alabama:																
Coal	4,995	5,000	1,102	1,096	8,799	8,658	4	9	113	99	13.30	12.47	3,777	6,935	153	19
Metal	1,064	930	312	284	2,585	2,338	---	---	34	22	13.15	9.41	608	1,011	24	7
Nonmetal and native asphalt	771	720	210	196	1,695	1,600	---	---	24	23	14.16	14.38	404	341	43	24
Sand and gravel	513	520	139	144	1,259	1,276	---	1	22	19	17.47	15.68	1,998	4,953	65	------
Stone	2,572	2,525	729	716	6,012	5,890	3	2	55	60	9.65	10.53	3,601	2,574	59	55
Total or average	9,915	9,690	2,491	2,437	20,350	19,761	7	12	248	223	12.53	11.89	2,931	4,272	344	105
Alaska:																
Coal and peat	137	135	38	37	321	315	1	---	24	23	77.95	72.96	19,251	511	5	4
Metal	270	235	44	30	369	260	1	1	6	7	18.98	30.80	16,794	27,089	81	1
Nonmetal	15	20	1	3	11	25	---	1	1	2	91.83	118.18	275	237,975	1	------
Sand and gravel	766	685	156	133	1,406	1,181	---	---	15	28	10.67	23.71	267	522	181	------
Stone	150	115	24	14	195	115	---	---	5	2	25.69	17.34	678	564	16	8
Total or average	1,338	1,185	263	218	2,301	1,897	2	2	51	62	23.04	33.74	5,598	7,339	284	13
Arizona:																
Coal	3	5	(2)	(2)	3	3	---	---	------	------	-----	-----	-----	-------	1	------
Metal	11,321	10,810	2,616	3,053	20,921	24,534	7	12	492	502	23.85	20.95	3,414	3,875	201	29
Nonmetal	293	220	65	47	547	404	---	---	10	6	18.30	14.87	364	468	41	14
Sand and gravel	1,158	1,020	262	242	2,121	1,936	---	2	44	42	20.74	22.72	2,413	6,970	202	------
Stone	412	405	108	108	873	867	---	---	13	10	14.90	11.53	587	293	94	33
Total or average	13,187	12,455	3,051	3,450	24,465	27,744	7	14	559	560	23.13	20.69	3,158	3,929	539	76
Arkansas:																
Coal	110	125	19	21	149	168	---	---	5	6	33.55	35.66	382	392	11	------
Metal	2,048	1,935	563	551	4,500	4,413	---	---	51	68	11.33	15.41	251	1,924	6	5
Nonmetal	1,029	1,060	259	263	2,073	2,101	---	---	59	68	28.46	32.37	507	605	39	18
Sand and gravel	776	630	195	158	1,804	1,425	---	---	34	27	18.85	18.95	253	348	188	------
Stone	1,345	1,260	366	347	3,157	2,975	---	1	79	51	25.02	17.48	2,638	3,358	145	66
Total or average	5,308	5,010	1,401	1,340	11,683	11,082	---	1	228	220	19.51	19.94	944	1,833	389	89
California:																
Coal	6	5	1	1	5	5	---	---	------	------	-----	-----	-----	-------	1	------
Metal	2,448	2,810	598	707	4,782	5,637	8	4	137	134	30.32	24.48	10,907	5,497	293	29
Nonmetal	4,440	4,620	1,281	1,218	10,284	9,767	6	---	182	163	18.28	16.69	4,153	1,017	220	79
Sand and gravel	5,694	5,955	1,283	1,421	10,405	11,465	4	1	207	277	20.28	24.25	3,778	1,159	827	------
Stone	4,208	4,565	1,212	1,326	9,664	10,839	2	4	107	121	11.28	11.53	1,723	2,845	324	121
Peat	30	14	6	2	49	15	---	---	------	------	-----	-----	-----	-------	4	------
Total or average	16,826	17,975	4,382	4,675	35,189	37,728	20	9	633	695	18.56	18.66	4,286	2,254	1,669	229

See footnotes at end of table.

Table 1.—Worktime and injury experience in the mineral industries (mines and mills) in the United States, by States[1]—Continued

State and industry group	Average men working daily		Man-days worked (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours				Count of operations 1967	
							Fatal		Nonfatal		Frequency		Severity			
	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	Mines	Mills
Colorado:																
Coal	1,354	1,815	297	294	2,334	2,293	2	6	72	71	31.71	33.57	6,368	16,936	75	3
Metal	4,693	4,535	1,284	1,217	10,264	9,927	7	3	407	360	40.34	36.57	6,764	3,754	438	25
Nonmetal	479	505	76	88	610	702	---	---	4	15	6.55	21.36	383	335	85	21
Sand and gravel	1,372	1,355	250	257	2,014	2,086	2	1	42	64	21.85	31.16	6,319	6,556	392	------
Stone	500	515	121	126	978	1,024	---	---	24	19	24.53	18.55	3,973	1,457	178	30
Peat	21	35	3	6	15	29	---	---	------	1	-----	35.03	-----	245	16	------
Total or average	8,419	8,260	2,031	1,988	16,215	16,061	11	10	549	530	34.54	33.62	6,237	5,698	1,184	79
Connecticut:																
Nonmetal	135	140	37	39	302	314	---	---	4	10	13.25	31.86	172	335	5	5
Sand and gravel	520	455	110	97	896	785	---	---	14	11	15.62	14.02	594	516	89	------
Stone	368	385	89	106	772	888	1	---	13	20	18.14	22.53	8,197	550	24	23
Total or average	1,023	980	235	241	1,970	1,986	1	---	31	41	16.25	20.64	3,508	502	118	28
Delaware:																
Nonmetal	13	10	3	3	26	28	---	---	1	1	38.46	42.93	154	730	1	1
Sand and gravel	77	65	17	14	134	112	---	---	1	1	7.45	8.91	171	71	12	------
Stone	10	10	2	2	20	20	---	---	--	--	-----	-----	-----	-------	1	1
Total or average	100	90	22	19	180	155	---	---	2	2	11.12	12.89	150	161	14	2
Florida:																
Metal	147	140	51	50	411	399	---	---	----	------	-----	-----	-----	-------	2	------
Nonmetal	3,785	3,540	1,130	1,074	9,051	8,602	3	---	73	85	8.40	9.88	3,385	273	42	37
Sand and gravel	337	315	86	80	765	690	---	1	24	18	31.38	27.52	616	9,521	60	------
Stone	2,201	2,300	686	685	5,637	6,125	2	2	105	95	18.98	15.84	2,735	2,821	88	69
Peat	19	32	5	8	42	58	---	---	1	------	23.55	-----	1,130	-------	6	------
Total or average	6,489	6,325	1,909	1,896	15,907	15,874	5	3	203	198	13.08	12.66	2,928	1,650	198	106
Georgia:																
Metal	181	120	51	36	406	308	---	---	11	7	27.07	23.10	276	548	14	4
Nonmetal and peat	4,000	3,490	1,153	1,055	9,334	8,480	---	---	284	215	30.43	25.35	1,191	691	86	45
Sand and gravel	243	240	64	60	571	546	---	---	15	10	26.26	18.32	527	771	33	------
Stone	2,980	3,035	771	800	6,445	6,913	---	2	163	121	25.29	17.79	1,262	2,308	90	80
Total or average	7,404	6,885	2,038	1,951	16,756	16,241	---	2	473	353	28.23	21.86	1,173	1,379	223	129
Hawaii:																
Nonmetal	111	100	9	9	70	71	---	---	------	1	-----	14.17	-----	213	30	4
Sand and gravel	21	30	3	3	26	22	---	---	1	------	38.44	-----	884	-------	6	------
Stone	527	495	126	115	1,035	940	---	---	33	40	31.88	42.56	673	1,603	43	20
Total or average	659	625	139	127	1,131	1,033	---	---	34	41	30.06	39.70	637	1,474	79	24

Idaho:																	
Metal	2,521	2,455	598	598	4,782	4,778	7	4	242	261	52.07	55.46	11,638	8,928	110	19
Nonmetal and peat	726	515	169	122	1,396	1,032	---	---	23	25	16.48	24.23	345	1,571	25	11
Sand and gravel	188	350	33	63	264	505	---	---	5	11	18.94	21.79	788	1,085	67	------
Stone	327	200	39	36	327	298	---	---	7	6	21.42	20.12	1,441	902	33	13
Total or average	3,762	3,525	839	818	6,769	6,613	7	4	277	303	41.96	46.42	8,393	6,820	235	43
Illinois:																	
Coal	8,049	7,900	2,167	2,092	16,886	16,200	19	15	743	750	45.13	47.16	8,883	7,775	77	41
Metal	52	50	13	13	105	104	---	---	4	8	38.23	76.90	210	1,365	3	1
Nonmetal	1,245	1,140	325	323	2,652	2,624	---	2	113	80	42.60	31.25	707	5,683	57	30
Sand and gravel	1,514	2,190	353	507	3,047	4,221	4	1	51	74	18.05	17.77	11,954	2,006	363	------
Stone	3,695	3,665	995	984	8,245	8,167	---	1	135	130	16.37	16.04	638	1,405	242	166
Peat	23	25	5	5	46	48	---	---	2	------	43.50	-----	174	-------	6	------
Total or average	14,578	14,940	3,857	3,923	30,981	31,362	23	19	1,048	1,042	34.57	33.80	6,249	5,132	748	238
Indiana:																	
Coal	2,017	2,265	545	577	4,249	4,638	8	4	126	156	31.53	34.50	12,295	6,318	47	14
Nonmetal	887	720	228	200	1,798	1,574	---	1	24	22	13.35	14.61	280	4,059	33	19
Sand and gravel	1,111	1,010	257	243	2,227	2,112	1	1	44	38	20.20	18.47	5,009	3,215	266	------
Stone	3,162	2,780	883	754	7,277	6,238	---	2	127	128	17.45	20.84	646	2,583	138	100
Peat	25	30	6	6	46	45	---	---	2	1	43.94	22.38	857	2,126	5	------
Total or average	7,202	6,810	1,919	1,779	15,597	14,607	9	8	323	345	21.29	24.17	4,401	4,018	489	133
Iowa:																	
Coal and peat	207	235	44	46	376	404	---	---	7	9	18.62	22.26	367	445	19	------
Nonmetal	1,045	705	281	190	2,263	1,533	---	---	52	53	22.98	34.57	578	907	29	26
Sand and gravel	1,073	1,040	229	219	2,080	2,003	1	1	40	34	19.71	17.48	3,572	3,325	332	------
Stone	2,489	2,570	661	698	5,704	5,971	3	4	85	85	15.43	14.90	3,712	4,388	266	112
Total or average	4,814	4,545	1,215	1,153	10,423	9,912	4	5	184	181	18.04	18.77	2,882	3,474	646	138
Kansas:																	
Coal	216	250	49	55	359	405	---	---	9	11	25.06	27.13	457	488	8	2
Metal	84	70	21	14	173	111	---	---	12	7	69.49	62.79	1,813	1,839	12	1
Nonmetal	1,224	1,235	291	311	2,318	2,495	1	---	50	74	22.00	29.66	2,932	978	37	21
Sand and gravel	787	965	198	231	1,700	2,034	1	---	23	39	14.12	19.17	3,820	479	220	------
Stone	1,623	1,650	417	422	3,442	3,495	---	1	41	38	11.91	11.16	452	2,045	184	77
Total or average	3,934	4,170	976	1,033	7,992	8,541	2	1	135	169	17.14	19.91	1,917	1,284	461	101
Kentucky:																	
Coal	24,213	23,000	4,646	4,414	36,890	34,900	52	58	1,660	1,475	46.41	43.92	10,358	11,746	1,694	49
Metal	40	65	11	19	90	151	---	1	15	15	166.25	106.03	2,383	41,101	1	1
Nonmetal	366	295	87	67	693	537	---	---	37	19	53.40	35.39	1,533	7,947	50	14
Sand and gravel	412	285	103	78	1,001	729	---	---	23	32	22.99	43.90	817	9,342	40	------
Stone	2,052	2,140	507	530	4,205	4,389	3	7	112	142	27.35	33.95	5,296	10,463	114	107
Total or average	27,083	25,740	5,354	5,108	42,879	40,708	55	66	1,847	1,683	44.36	42.96	9,480	11,623	1,899	171

See footnotes at end of table.

Table 1.—Worktime and injury experience in the mineral industries (mines and mills) in the United States, by States[1]—Continued

State and industry group	Average men working daily		Man-days worked (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours				Count of operations 1967	
							Fatal		Nonfatal		Frequency		Severity			
	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	Mines	Mills
Louisiana:																
Metal	820	810	299	296	2,394	2,364	---	---	9	11	3.76	4.65	198	145	------	2
Nonmetal	1,925	2,070	581	613	4,719	5,481	4	24	90	116	19.92	25.54	5,771	27,781	30	20
Sand and gravel	1,228	640	291	150	2,600	1,364	---	1	46	18	17.70	13.93	388	4,782	69	------
Stone	692	680	232	230	1,946	1,954	---	---	38	47	19.53	24.06	5,118	638	14	17
Total or average	4,665	4,200	1,404	1,288	11,659	11,163	4	25	183	192	16.04	19.44	3,817	14,367	113	39
Maine:																
Metal and peat	68	80	16	23	131	162	---	---	1	6	7.63	36.93	229	535	4	------
Nonmetal	107	85	28	18	184	148	---	---	5	3	27.12	20.29	602	162	13	4
Sand and gravel	1,490	1,435	243	241	2,087	2,084	---	---	39	42	18.69	20.15	373	461	115	------
Stone	466	410	101	89	819	726	1	---	15	18	19.54	24.79	8,342	705	40	38
Total or average	2,131	2,010	388	371	3,221	3,121	1	---	60	69	18.94	22.11	2,405	507	172	42
Maryland and District of Columbia:																
Coal and peat	350	365	74	77	596	628	1	---	7	7	13.41	11.14	12,529	828	75	------
Nonmetal[3]	430	155	103	39	847	313	---	---	36	16	42.52	51.04	604	1,215	17	13
Sand and gravel	827	665	217	175	1,878	1,522	2	---	45	33	25.03	21.68	7,267	821	84	------
Stone	1,095	1,075	296	298	2,510	2,461	---	---	57	59	22.71	23.97	453	481	41	37
Total or average	2,702	2,260	689	589	5,830	4,925	3	---	145	115	25.38	23.35	3,905	458	217	50
Massachusetts:																
Nonmetal and peat	64	70	18	20	146	158	---	---	10	11	68.26	69.42	1,406	1,950	4	1
Sand and gravel	1,016	930	232	211	1,905	1,741	---	---	38	32	19.94	18.38	601	892	206	------
Stone	957	915	255	240	2,059	1,931	2	---	50	45	25.26	23.30	6,496	639	48	39
Total or average	2,037	1,920	506	471	4,111	3,831	2	---	98	88	24.33	22.97	3,583	809	258	40
Michigan:																
Metal	5,549	5,180	1,565	1,549	12,503	12,393	11	1	481	400	39.35	32.36	6,806	1,850	23	13
Nonmetal	1,669	1,790	472	491	3,777	3,924	2	---	54	84	14.83	21.41	3,524	640	59	17
Sand and gravel	2,474	2,570	526	554	4,619	4,789	---	---	93	104	20.14	21.72	705	963	579	------
Stone	3,391	3,410	1,000	983	8,025	7,918	---	---	62	75	7.73	9.47	373	1,134	63	46
Peat	157	167	29	31	261	293	---	---	2	------	7.67	-----	31	-------	27	------
Total or average	13,240	13,120	3,591	3,608	29,184	29,316	13	1	692	663	24.16	22.65	3,586	1,331	751	76
Minnesota:																
Metal	9,378	9,025	2,758	2,856	22,073	22,867	6	4	79	87	3.85	3.98	2,100	1,441	52	28
Nonmetal	208	155	54	41	436	332	---	---	21	12	48.16	36.19	2,032	205	7	6
Sand and gravel	2,200	2,145	380	367	3,427	3,282	1	1	58	59	17.22	18.28	2,404	2,252	719	------

Stone	1,450	1,415	379	378	8,095	8,060	---	---	47	55	15.19	17.98	447	1,668	97	52
Peat	30	37	3	6	25	26	---	---	1	2	39.70	78.25	397	861	6	------
Total or average	13,266	12,780	3,575	3,644	29,055	29,566	7	5	206	215	7.33	7.44	1,958	1,540	881	86
Mississippi:																
Metal	3	-------	1	-------	6	--------	---	---	------	------	-----	-----	-----	-------	1	------
Nonmetal	913	795	237	200	1,905	1,610	1	---	48	28	25.72	17.39	3,954	627	87	23
Sand and gravel	444	360	116	88	1,140	836	---	---	24	16	21.05	19.14	412	4,059	56	------
Stone	253	185	63	45	511	365	---	---	7	2	13.69	5.48	2,093	107	14	14
Total or average	1,613	1,340	417	333	3,563	2,811	1	---	79	46	22.45	16.37	2,547	1,580	108	37
Missouri:																
Coal	365	420	110	124	834	941	---	---	15	18	17.99	19.12	405	440	17	4
Metal	2,292	2,690	622	732	4,974	5,858	2	4	188	242	38.20	41.99	3,323	5,257	22	5
Nonmetal and native asphalt	983	915	226	217	1,822	1,756	---	---	56	57	30.73	32.46	2,370	770	120	23
Sand and gravel	556	565	134	135	1,139	1,140	---	---	16	20	14.05	17.55	1,104	774	89	------
Stone	4,217	4,140	1,106	1,116	9,254	9,261	3	3	176	191	19.34	20.95	2,734	2,464	241	184
Total or average	8,413	8,730	2,197	2,325	18,023	18,957	5	7	451	528	25.30	28.22	2,649	2,968	489	216
Montana:																
Coal and peat	78	75	11	11	90	87	---	---	9	9	100.01	103.08	2,634	2,680	16	1
Metal	4,253	2,960	793	617	6,343	4,946	7	3	125	75	20.81	15.77	9,357	5,151	91	9
Nonmetal	776	765	196	195	1,566	1,572	1	2	54	51	35.12	33.71	6,146	8,924	24	8
Sand and gravel	1,083	595	151	102	1,273	822	---	---	25	17	19.64	20.68	399	360	163	------
Stone	875	325	85	79	678	644	---	---	17	7	25.07	10.87	350	118	78	43
Total or average	6,565	4,725	1,236	1,005	9,951	8,072	8	5	230	159	23.92	20.32	7,031	4,970	372	61
Nebraska:																
Nonmetal	44	15	10	3	82	24	---	---	2	------	24.49	-----	147	-------	5	4
Sand and gravel	879	830	178	176	1,703	1,651	1	1	10	24	6.46	15.15	3,835	4,195	306	------
Stone	526	480	140	134	1,167	1,104	---	---	20	13	17.14	11.77	444	606	43	27
Total or average	1,449	1,325	328	313	2,951	2,779	1	1	32	37	11.18	13.67	2,392	2,732	354	31
Nevada:																
Metal	1,979	1,835	467	471	3,735	3,777	2	3	99	91	27.04	24.89	4,035	5,768	105	18
Nonmetal and peat [4]	719	740	183	185	1,468	1,479	1	---	44	36	30.66	24.34	4,601	519	50	16
Sand and gravel	686	605	150	128	1,187	1,014	---	---	20	20	16.84	19.73	442	471	113	------
Stone	323	320	79	84	634	672	---	1	10	14	15.78	22.33	393	9,385	39	24
Total or average	3,707	3,505	880	868	7,024	6,942	3	4	173	161	25.06	23.77	3,218	4,226	307	58
New Hampshire:																
Nonmetal and peat [4]	48	45	13	15	101	118	---	---	3	1	29.73	8.47	208	17	5	1
Sand and gravel	384	375	82	77	708	660	---	---	16	14	22.59	21.21	418	924	74	------
Stone	162	120	40	30	322	237	---	---	7	4	21.76	16.85	603	438	33	8
Total or average	594	545	135	121	1,131	1,016	---	---	26	19	22.99	18.71	452	705	112	9

See footnotes at end of table.

Table 1.—Worktime and injury experience in the mineral industries (mines and mills) in the United States, by States[1]—Continued

State and industry group	Average men working daily		Man-days worked (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours				Count of operations 1967	
							Fatal		Nonfatal		Frequency		Severity			
	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	Mines	Mills
New Jersey:																
Metal	185	175	52	51	417	413	---	1	22	22	52.71	55.69	1,706	15,627	2	2
Nonmetal	295	355	71	83	565	664	---	---	17	20	30.07	30.13	867	568	16	12
Sand and gravel	1,114	1,045	273	255	2,274	2,104	1	---	45	56	20.23	26.62	3,219	781	123	------
Stone	856	985	222	257	1,846	2,159	1	---	57	68	31.41	31.49	4,009	1,220	35	32
Peat	21	21	4	5	34	36	---	---	------	------	-----	-----	-----	-------	5	------
Total or average	2,471	2,575	622	651	5,137	5,376	2	1	141	166	27.84	31.06	3,100	2,066	181	46
New Mexico:																
Coal	281	275	68	67	539	529	---	---	22	21	40.84	39.66	2,083	2,023	10	1
Metal	3,460	4,160	850	1,098	6,804	8,802	3	4	276	257	41.00	29.65	4,315	3,601	123	18
Nonmetal	2,745	2,230	906	683	7,246	5,504	6	3	209	187	29.67	34.52	5,685	3,926	58	25
Sand and gravel	1,181	960	197	160	1,617	1,320	1	---	32	38	20.41	28.79	7,824	2,098	168	------
Stone	255	255	51	55	409	444	---	---	8	5	19.56	11.26	259	261	79	31
Total or average	7,922	7,875	2,071	2,064	16,615	16,600	10	7	547	508	33.52	31.02	5,082	3,449	438	75
New York:																
Metal	1,565	1,310	417	356	3,334	2,844	---	1	39	34	11.70	12.31	884	2,661	6	6
Nonmetal	2,039	2,190	514	576	4,224	4,660	---	---	117	120	27.70	25.75	766	1,038	39	28
Sand and gravel	2,173	2,230	444	466	3,716	3,812	1	---	76	88	20.72	23.08	2,088	519	369	------
Stone	3,586	3,365	901	859	7,420	7,066	---	1	96	109	12.94	15.57	579	1,701	112	103
Peat	11	10	2	2	17	16	---	---	------	1	-----	61.94	-----	3,097	5	------
Total or average	9,374	9,105	2,278	2,259	18,711	18,399	1	2	328	352	17.58	19.24	886	1,438	531	137
North Carolina:																
Metal	2	5	(2)	(2)	(2)	(2)	---	---	------	------	-----	-----	-----	-------	1	------
Nonmetal	1,741	1,955	426	503	3,417	4,068	---	1	109	120	31.90	29.74	1,139	2,095	66	47
Sand and gravel	834	895	193	204	1,733	1,798	---	1	52	39	30.01	22.25	631	3,725	133	------
Stone	1,899	1,975	483	461	4,020	3,807	2	2	55	50	14.18	13.66	3,480	7,567	97	81
Total or average	4,476	4,830	1,102	1,169	9,170	9,674	2	4	216	209	23.77	22.02	2,069	4,552	297	128
North Dakota:																
Coal and Peat	279	275	60	60	482	474	---	1	9	9	18.69	21.10	469	13,134	28	1
Metal	7	-------	(2)	-------	1	--------	---	---	------	------	-----	-----	-----	-------	2	------
Nonmetal	35	(5)	9	1	69	4	---	---	4	------	57.71	-----	519	-------	4	1
Sand and gravel	618	840	98	135	933	1,259	1	---	15	23	17.15	18.26	6,677	890	340	------
Stone	119	95	23	16	187	129	---	---	------	1	-----	7.74	-----	108	13	13
Total or average	1,058	1,210	191	211	1,672	1,867	1	1	28	33	17.34	18.21	3,881	3,605	387	15

Ohio:																
Coal	7,432	7,700	1,849	1,887	14,846	15,020	4	13	400	435	27.21	29.95	2,823	6,501	378	19
Nonmetal	2,571	2,250	682	608	5,439	4,840	---	1	132	109	24.27	22.73	577	1,686	158	48
Sand and gravel	2,361	2,305	546	553	4,560	4,611	4	2	62	76	14.48	16.91	5,796	3,037	404	------
Stone	5,504	5,470	1,493	1,504	12,095	12,261	1	7	168	190	13.97	16.07	1,268	4,003	189	168
Peat	18	16	2	2	15	12	---	---	------	------	-----	-----	-----	-------	14	------
Total or average	17,886	17,775	4,572	4,553	36,954	36,748	9	23	762	810	20.86	22.72	2,349	4,597	1,143	235
Oklahoma:																
Coal	252	290	41	47	324	366	1	---	5	6	18.51	16.39	19,110	639	19	3
Metal	399	350	108	98	867	776	1	---	34	33	40.38	42.53	14,524	767	72	3
Nonmetal	524	575	127	137	1,009	1,095	1	---	30	30	30.71	27.40	8,216	452	25	14
Sand and gravel	266	270	73	73	617	617	---	---	17	14	27.55	22.68	319	1,471	70	------
Stone	1,167	1,210	306	323	2,556	2,687	---	1	69	58	26.99	21.96	622	2,675	120	91
Total or average	2,608	2,700	655	678	5,374	5,541	3	1	155	141	29.40	25.63	5,371	1,700	306	111
Oregon:																
Coal and peat	9	5	1	1	6	7	---	---	------	1	-----	152.09	-----	760	2	------
Metal	150	140	30	25	245	201	---	---	11	4	44.91	19.87	1,821	760	32	1
Nonmetal	146	100	24	19	194	148	---	---	2	5	10.29	33.73	1,425	11,058	40	11
Sand and gravel	2,144	1,545	441	326	3,384	2,611	---	2	74	64	21.87	25.28	441	5,162	293	------
Stone	1,117	1,025	265	256	2,102	2,052	1	---	59	62	28.54	30.21	3,426	1,079	273	194
Total or average	3,566	2,815	761	627	5,932	5,019	1	2	146	136	24.78	27.49	1,588	3,485	640	206
Pennsylvania:																
Bituminous coal	22,504	21,500	5,275	4,933	42,247	39,740	27	30	942	880	22.94	22.87	5,642	6,321	914	77
Anthracite	7,750	6,932	1,701	1,508	12,359	11,011	9	4	609	504	50.00	46.13	5,511	4,182	557	135
Metal	1,602	1,475	448	441	3,586	3,538	2	1	31	32	9.20	9.33	3,663	2,124	3	3
Nonmetal	1,428	1,405	357	354	2,920	2,875	---	1	89	103	30.48	36.18	740	6,194	112	41
Sand and gravel	1,197	1,235	287	296	2,410	2,488	1	---	55	70	23.24	28.14	3,730	3,421	114	------
Stone	8,351	8,305	2,227	2,246	18,304	18,370	9	3	281	279	15.84	15.35	3,439	1,664	287	240
Peat	46	50	10	12	84	91	---	---	4	1	47.87	10.98	3,770	44	8	------
Total or average	42,878	40,930	10,306	9,789	81,910	78,115	48	39	2,011	1,869	25.14	24.41	4,810	4,630	1,995	496
Rhode Island:																
Sand and gravel	204	200	39	38	312	306	---	---	3	7	9.60	22.91	189	288	18	------
Stone	47	70	11	18	98	148	---	---	4	3	41.02	20.28	728	1,054	6	3
Total or average	251	270	50	56	410	454	---	---	7	10	17.08	22.05	317	538	24	3
South Carolina:																
Nonmetal and peat	1,004	945	251	241	2,008	1,942	---	1	35	30	17.43	15.96	2,655	4,157	44	25
Sand and gravel	405	360	100	90	815	805	---	---	15	16	18.39	19.86	423	504	30	------
Stone	841	775	225	202	1,870	1,665	1	---	42	29	23.00	17.41	3,582	3,365	18	15
Total or average	2,250	2,080	576	532	4,694	4,413	1	1	92	75	19.81	17.22	2,636	3,191	92	40

See footnotes at end of table.

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Table 1.—Worktime and injury experience in the mineral industries (mines and mills) in the United States, by States[1]—Continued

State and industry group	Average men working daily		Man-days worked (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours				Count of operations 1967	
							Fatal		Nonfatal		Frequency		Severity			
	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	Mines	Mills
South Dakota:																
Coal	5	5	1	1	4	4	---	---	------	------	-----	-----	-----	-------	1	------
Metal	1,695	1,605	528	494	4,222	3,953	---	2	114	114	27.00	29.34	2,729	4,132	14	4
Nonmetal	266	215	62	41	518	330	---	1	6	7	11.71	24.22	43	18,846	43	6
Sand and gravel	977	735	150	116	1,359	1,049	---	---	25	23	18.40	21.93	445	780	393	------
Stone	468	470	105	109	894	919	---	---	15	14	16.78	15.23	302	283	39	15
Total or average	3,406	3,030	846	761	6,991	6,256	---	3	160	158	22.88	25.73	1,776	3,770	490	25
Tennessee:																
Coal	1,917	1,920	375	373	3,024	2,976	4	6	120	106	41.00	37.64	10,886	13,416	195	1
Metal	1,672	1,680	439	474	3,523	3,792	3	2	107	105	31.23	28.21	7,062	6,745	15	6
Nonmetal	780	665	178	162	1,464	1,344	---	---	36	33	24.60	24.55	535	1,111	60	23
Sand and gravel	605	555	152	142	1,330	1,217	1	1	18	25	14.28	21.37	4,938	6,891	89	------
Stone	2,830	2,750	734	751	6,023	6,175	---	3	102	112	16.93	18.62	2,749	3,363	134	118
Total or average	7,754	7,570	1,879	1,902	15,364	15,504	8	12	383	381	25.45	25.35	5,318	6,201	493	148
Texas:																
Coal	102	115	28	32	224	252	---	---	3	4	13.42	15.85	282	383	2	------
Metal	1,571	1,705	481	481	3,852	3,849	1	---	54	32	14.28	8.31	2,343	594	7	6
Nonmetal and native asphalt	3,316	3,075	970	913	7,859	7,394	3	---	170	176	22.01	23.80	2,789	1,057	137	69
Sand and gravel	2,117	2,050	559	533	5,126	4,887	1	4	155	119	30.43	25.17	2,111	5,362	311	------
Stone	4,604	4,485	1,436	1,386	12,052	11,677	3	1	211	221	17.76	19.01	1,959	1,225	256	225
Total or average	11,710	11,435	3,475	3,345	29,112	28,060	8	5	593	552	20.64	19.85	2,248	1,807	713	300
Utah:																
Coal	1,240	1,205	262	259	2,054	2,019	---	2	106	104	51.60	52.50	3,228	7,746	27	6
Metal	5,313	5,190	1,140	1,351	9,123	10,810	4	3	196	219	21.92	20.54	3,517	2,598	172	11
Nonmetal	1,008	980	268	270	2,147	2,159	---	---	113	136	52.62	62.98	1,750	1,054	42	20
Sand and gravel	598	590	122	113	1,008	931	1	---	24	20	24.80	21.48	6,796	7,080	172	------
Stone	401	375	105	97	836	775	1	1	11	5	14.35	7.74	7,326	7,883	51	18
Native asphalt	222	237	55	59	440	470	---	---	23	15	52.25	31.92	5,306	780	12	6
Total or average	8,782	8,580	1,952	2,148	15,610	17,164	6	6	473	499	30.69	29.42	3,702	3,437	476	61
Vermont:																
Nonmetal and peat	294	315	85	89	682	717	---	---	15	26	22.01	36.27	726	823	6	5
Sand and gravel	346	265	66	52	560	451	---	---	10	8	17.87	17.75	341	366	53	------
Stone	1,769	1,715	445	419	3,606	3,434	---	---	125	110	34.67	32.03	745	3,267	75	44
Total or average	2,409	2,300	596	560	4,847	4,602	---	---	150	144	30.95	31.29	695	2,602	134	49

Virginia:																
Coal	11,550	12,100	2,266	2,359	17,999	18,895	28	12	869	856	49.84	45.94	11,823	6,166	992	33
Metal	336	320	90	84	718	672	---	---	3 2	42	44.58	62.48	599	1,764	3	3
Nonmetal	700	630	184	165	1,474	1,314	---	---	39	31	26.46	23.58	491	778	38	22
Sand and gravel	605	555	145	136	1,358	1,228	---	---	84	17	25.03	13.84	373	370	85	------
Stone	3,784	3,955	1,003	1,050	8,331	8,629	4	3	171	201	21.00	23.64	3,993	2,693	156	187
Total or average	16,975	17,555	3,687	3,794	29,880	30,739	32	15	1,145	1,147	39.39	37.80	8,291	4,633	1,274	195
Washington:																
Coal	45	45	7	7	53	52	---	---	9	9	168.80	171.77	5,008	5,153	5	1
Metal	370	200	78	53	624	426	---	---	34	42	54.46	98.55	1,451	2,335	17	6
Nonmetal	130	100	14	9	111	74	---	---	4	3	36.12	40.75	740	1,453	33	8
Sand and gravel	1,582	1,405	320	287	2,585	2,297	---	2	65	57	25.14	25.68	1,204	9,329	410	------
Stone	1,272	1,200	250	250	2,007	2,007	---	3	29	21	14.45	11.96	524	9,363	212	114
Peat	30	27	6	4	47	31	---	---	1	------	21.30	-----	2,130	-------	11	------
Total or average	3,429	2,970	675	611	5,428	4,888	---	5	142	132	26.16	28.03	1,017	8,510	688	129
West Virginia:																
Coal	43,556	43,100	9,512	9,157	75,221	72,890	62	150	4,217	3,875	56.89	55.25	8,039	15,273	1,549	156
Nonmetal	785	775	195	242	1,559	1,934	---	1	18	14	11.55	7.76	429	3,495	16	6
Sand and gravel	218	215	61	57	530	505	---	---	13	12	24.52	23.78	792	709	16	------
Stone	1,155	1,305	323	333	2,600	2,673	1	2	42	31	16.54	12.35	2,716	4,974	84	45
Total or average	45,714	45,390	10,091	9,789	79,910	78,003	63	153	4,290	3,932	54.47	52.40	7,670	14,533	1,665	207
Wisconsin:																
Metal	213	215	59	49	475	394	---	---	36	21	75.79	53.36	1,501	2,866	13	6
Nonmetal	107	100	12	11	97	93	---	---	1	1	10.31	10.80	24,742	108	5	3
Sand and gravel	2,009	2,055	407	409	3,589	3,572	3	---	69	73	20.06	20.43	5,358	736	465	------
Stone	1,950	1,880	420	401	3,513	3,400	2	1	99	81	28.75	24.12	4,522	2,541	288	135
Peat	12	10	2	2	15	18	---	---	1	------	67.97	-----	476	-------	3	----
Total or average	4,291	4,260	900	873	7,689	7,477	5	1	206	176	27.44	23.67	4,973	1,659	774	144
Wyoming:																
Coal	318	310	71	71	549	540	---	1	14	14	25.50	27.80	2,125	12,442	15	1
Metal	1,686	1,725	415	462	3,413	3,889	1	4	89	104	26.37	27.77	4,389	7,272	68	9
Nonmetal	1,326	1,250	324	358	2,637	2,894	1	1	52	46	20.10	16.24	2,871	2,841	52	18
Sand and gravel	980	810	183	152	1,444	1,252	---	1	25	23	17.31	19.18	385	5,666	196	------
Stone	267	250	56	62	453	500	---	---	13	14	28.68	28.02	7,064	766	59	11
Total or average	4,577	4,345	1,050	1,105	8,497	9,074	2	7	193	201	22.95	22.92	3,234	5,586	390	39
United States totals:[6]																
Coal	139,312	136,800	30,611	29,598	241,774	234,385	222	311	10,115	9,460	42.75	41.68	7,699	10,071	6,885	569
Peat	506	533	95	99	785	798	---	---	15	8	19.11	10.02	733	244	135	------
Native asphalt	393	399	100	103	821	837	---	---	33	23	40.21	27.49	2,985	672	16	10
Metal	69,424	67,000	17,816	18,634	142,744	149,675	73	58	3,468	3,365	24.81	22.86	4,436	3,493	2,031	281
Nonmetal	49,447	46,600	13,330	12,661	107,400	102,460	30	40	2,551	2,465	24.03	24.46	2,566	3,280	2,176	983
Sand and gravel	52,363	49,900	11,296	10,948	96,645	93,155	32	25	1,919	1,990	20.19	21.65	2,933	2,626	10,168	------
Stone	84,765	84,000	22,548	22,524	186,227	186,465	46	58	3,267	3,260	17.79	17.80	2,308	2,702	5,373	3,443
Total or average	396,210	385,300	95,796	94,568	776,396	767,775	403	492	21,368	20,575	28.04	27.44	4,491	5,169	26,784	5,286

See footnotes at end of table.

Table 1.—Worktime and injury experience in the mineral industries (mines and mills) in the United States, by States[1]—Continued

State and industry group	Average men working daily		Man-days worked (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours				Count of operations 1967	
							Fatal		Nonfatal		Frequency		Severity			
	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	Mines	Mills
United States totals[6]—Continued																
Oil and natural gas[7]	445,562	466,652	NA	NA	938,946	986,952	88	102	8,776	9,069	9.44	9.29	981	985	NA	NA
Coke	13,701	13,093	4,873	4,696	38,956	37,546	9	7	226	204	6.03	5.62	1,602	1,875	------	72
Blast-furnace-slag	1,721	1,724	439	454	3,539	3,697	3	1	53	57	15.82	15.69	5,762	2,454	------	70
Primary nonferrous smelting and refining	43,046	41,500	13,194	13,590	105,511	109,010	9	4	937	1,155	8.97	10.63	1,029	725	------	91
Grand total or average	900,240	908,300	NA	NA	1,863,349	1,904,980	512	606	31,360	31,060	17.10	16.62	2,468	2,677	NA	NA

NA Not available.

[1] All data for 1967 are final. Data for 1968 are preliminary except for anthracite, peat, native asphalt, oil and natural gas, coke, and slag.

[2] Less than 500.

[3] No nonmetal produced in District of Columbia in 1968.

[4] No peat produced in Nevada and New Hampshire during 1968.

[5] Less than 3.

[6] Data may not add to totals shown because of independent rounding.

[7] Includes data on officeworkers.

Table 2.—Employment and injury experience in the mineral industries

Year	Average men working daily	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
			Fatal	Nonfatal	Fatal	Nonfatal
1964	892,422	1,849,921	542	32,413	0.29	17.52
1965	907,476	1,899,895	538	32,800	.28	17.26
1966	915,964	1,925,695	544	32,823	.28	17.04
1967	900,240	1,863,349	512	31,360	.27	16.83
1968 p	908,300	1,904,980	606	31,060	.32	16.30

p Preliminary.

Table 3.—Work stoppages in certain mineral industries in the United States

Industry and year	Work stoppages	
	Number	Man-days lost (thousands)
Coal mining:		
Anthracite:		
1964	5	(1)
1965	3	1.7
1966	4	8.3
1967	3	1.4
1968	2	4.2
Bituminous and lignite:		
1964	111	340.0
1965	145	258.0
1966	160	629.0
1967	207	[2] 158.0
1968	266	[2] 956.6
Crude petroleum and natural gas:		
1964	---	-------
1965	---	-------
1966	1	50.7
1967	2	(1)
1968	---	-------
Oil and gas field services:		
1964	---	-------
1965	3	(1)
1966	1	2.6
1967	3	(1)
1968	3	3.0
Petroleum refining:		
1964	14	162.0
1965	7	[2] 31.4
1966	5	5.6
1967	15	103.0
1968	6	50.8
Metal mining:		
Iron:		
1964	3	5.5
1965	3	21.9
1966	---	-------
1967	---	-------
1968	2	32.7
Copper:		
1964	11	385.0
1965	3	60.5
1966	6	25.2
1967	7	2,660.0
1968	6	[2] 1,453.1
Lead-zinc:		
1964	9	14.9
1965	6	43.3
1966	4	[2] 66.0
1967	3	[2] 93.4
1968	1	[2] 31.1
Gold-silver:		
1964	---	[2] 21.6
1965	---	-------
1966	---	-------
1967	2	26.9
1968	---	[2] 31.1
Ferroalloy metal ores:		
1964	---	-------
1965	---	-------
1966	1	(1)
1967	1	(1)
1968	---	-------
Metal mining—Continued		
Miscellaneous metal ores:		
1964	---	-------
1965	---	-------
1966	---	-------
1967	1	1.0
1968	---	-------
Primary smelting and refining of nonferrous metals:		
1964	11	170.0
1965	8	51.6
1966	15	182.0
1967	12	1,420.0
1968	11	[2] 915.0
Mining and quarrying of nonmetallic minerals (except fuels):		
Dimension stone:		
1964	1	2.2
1965	3	[2] 2.1
1966	1	(1)
1967	---	-------
1968	1	3.4
Crushed and broken stone:		
1964	8	24.7
1965	9	33.0
1966	7	9.2
1967	1	9.0
1968	11	17.1
Sand and gravel:		
1964	2	(1)
1965	10	3.5
1966	7	1.9
1967	[2] 15	26.8
1968	6	6.3
Clay, ceramic and refractory minerals:		
1964	1	(1)
1965	---	-------
1966	---	-------
1967	---	-------
1968	2	6.2
Chemical and fertilizer mineral mining:		
1964	4	12.5
1965	1	(1)
1966	2	(1)
1967	10	38.9
1968	1	7.0
Miscellaneous nonmetallic minerals (except fuels):		
1964	---	-------
1965	1	(1)
1966	---	-------
1967	1	(1)
1968	---	-------
Cement, hydraulic:		
1964	1	7.4
1965	14	82.3
1966	2	1.7
1967	9	67.4
1968	2	4.7

[1] Less than 100 man-days.
[2] Includes idleness from stoppages which began in the previous year.

Source: U.S. Department of Labor, Bureau of Labor Statistics.

The Mineral Industry of Alabama

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Alabama for collecting information on all minerals except fuels.

By Ronald P. Hollenbeck [1] and W. Everett Smith [2]

The value of mineral production in Alabama continued to increase and reached a new high of $260 million, 3 percent above the previous high established in 1967. Record high values were reported for bentonite, crushed marble, lime, miscellaneous clay, portland cement, salt, sand and gravel, and scrap mica. The value of coal, total cement, petroleum, and stone accounted for 87 percent of the State's total value of mineral production.

Alabama ranked second among the States in the production of bauxite and scrap mica and third in kaolin, masonry cement, and native asphalt.

Selected indicators of business activity in Alabama continued to show increases in 1968. The number of persons employed in the nonagricultural sector averaged 956,200 per month during the year, an increase of 1 percent above the 1967 level. The Bureau of Labor Statistics, U.S. Department of Labor, reported that employment in all of Alabama's nonagricultural industries, excepting mining, expanded during the period 1939–67; mining employment, however, dropped from 26,400 to 8,500 during the same period. Total personal income in 1968 and per capita income increased 8.2 percent and 7.5 percent, respectively. Construction activity, as measured by housing units authorized and value,

Table 1.—Mineral production in Alabama [1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Cement: [2]				
Masonry ... thousand 280-pound barrels	2,377	$6,938	2,523	$7,309
Portland ... thousand 376-pound barrels	15,364	46,510	15,514	48,147
Clays ... thousand short tons	2,724	7,422	2,793	6,995
Coal (bituminous) ... do	15,486	110,696	16,440	115,815
Iron ore (usable) ... thousand long tons, gross weight	1,472	8,286	1,151	6,780
Lime ... thousand short tons	624	7,719	773	8,933
Natural gas ... million cubic feet	248	31	230	30
Petroleum (crude) ... thousand 42-gallon barrels	7,348	19,500	7,635	20,385
Sand and gravel ... thousand short tons	7,229	7,969	8,140	9,130
Stone ... do	18,371	33,346	20,643	33,847
Value of items that cannot be disclosed: Native asphalt, bauxite, slag cement, scrap mica, salt, and talc	XX	2,974	XX	2,300
Total	XX	251,391	XX	259,621
Total 1957–59 constant dollars	XX	r 256,223	XX	p 257,878

p Preliminary. r Revised. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes certain cement; included with "Value of items that cannot be disclosed."

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[2] Chief, Economic Geology Division, Geological Survey of Alabama, Tuscaloosa, Ala.

Table 2.—Value of mineral production in Alabama, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Autauga	$299	W	Sand and gravel.
Baldwin	188	W	Sand and gravel, petroleum, miscellaneous clay.
Barbour	W	$399	Bauxite, sand and gravel, iron ore.
Bibb	W	3,010	Coal, limestone, sand and gravel, miscellaneous clay.
Blount	W	2,097	Coal, iron ore, cement, fire clay.
Butler	W	44	Iron ore.
Calhoun	W	2,556	Fire clay, limestone, miscellaneous clay.
Cherokee	W	W	Sand and gravel.
Chilton	W	W	Do.
Choctaw	1,091	2,350	Petroleum.
Clarke	W	W	Sand and gravel, petroleum.
Coffee	50	W	Sand and gravel.
Colbert	W	W	Limestone, native asphalt.
Covington	W	W	Limestone.
Crenshaw	W	W	Sand and gravel.
Cullman	W	W	Coal.
Dale	-------	W	Sand and gravel.
Dallas	W	1,122	Lime, sand and gravel, sandstone.
De Kalb	W	W	Limestone.
Elmore	W	W	Sand and gravel, miscellaneous clay.
Escambia	1,523	W	Petroleum, sand and gravel, miscellaneous clay.
Etowah	1,005	W	Limestone, coal, sand and gravel.
Fayette	W	W	Coal, sand and gravel.
Franklin	3,127	3,811	Iron ore, limestone, sand and gravel, fire clay.
Geneva	W	W	Sand and gravel.
Greene	W	-------	
Hale	2	W	Sand and gravel.
Henry	W	W	Kaolin, bauxite.
Houston	W	W	Sand and gravel.
Jackson	W	W	Coal, limestone.
Jefferson	106,206	105,955	Coal, cement, limestone, iron ore, miscellaneous clay, sandstone.
Lee	W	W	Limestone.
Limestone	70	70	Do.
Lowndes	W	W	Bentonite.
Macon	796	918	Sand and gravel.
Madison	W	W	Limestone, miscellaneous clay.
Marengo	W	W	Cement, limestone, sand and gravel.
Marion	W	W	Coal, kaolin, natural gas.
Marshall	W	W	Limestone, sand and gravel.
Mobile	W	W	Petroleum, cement, oystershell, sand and gravel, miscellaneous clay.
Monroe	34	62	Sand and gravel.
Montgomery	W	1,917	Sand and gravel, miscellaneous clay.
Morgan	W	W	Limestone, sand and gravel.
Pike	649	W	Iron ore.
Randolph	W	W	Mica.
Russell	W	W	Miscellaneous clay, sand and gravel.
St. Clair	W	W	Cement, limestone, fire clay, miscellaneous clay.
Shelby	26,066	27,898	Lime, cement, limestone, coal, miscellaneous clay, iron ore.
Sumter	W	W	Sand and gravel.
Talladega	W	8,017	Marble, limestone, sand and gravel, talc.
Tuscaloosa	3,742	4,461	Coal, sand and gravel, iron ore.
Walker	W	W	Coal, fire clay, miscellaneous clay.
Washington	W	W	Limestone, salt.
Winston	W	W	Coal.
Undistributed	106,543	94,934	
Total	251,391	259,621	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Bullock, Chambers, Clay, Cleburne, Conecuh, Coosa, Lamar, Lauderdale, Lawrence, Perry, Pickens, Tallapoosa, and Wilcox.

continued to increase; units authorized increased 28.7 percent and value 24.5 percent above 1967. Cash receipts from farm marketing were valued at $637.6 million, an increase of 7.4 percent over 1967 receipts. Total sales of electric energy increased 7.2 percent over 1967 sales, with residential use accounting for most of the increase. Value of export and import trading handled through the Mobile Customs District exceeded $753 million; exports decreased 2.1 percent and imports increased 21.9 percent over 1967 trade.

Table 3.—Selected indicators of Alabama business activity

	1967	1968	Change (percent)
Employment, monthly average:			
Total nonagricultural .... thousands..	[r] 946.3	956.2	+1.0
Manufacturing .... do....	[r] 298.4	303.2	+1.6
Nonmanufacturing .... do....	[r] 647.9	653.0	+.8
Personal income:			
Total .... millions..	[r] $7,656	$8,286	+8.2
Per capita	[r] $2,167	[p] $2,329	+7.5
Housing construction activity:			
Units authorized .... thousands..	12.9	16.6	+28.7
Value of construction .... millions..	$151.6	$188.7	+24.5
Farm marketing, cash receipts .... do....	[r] $593.8	$637.6	+7.4
Mineral production .... do....	$251.4	$259.6	+3.3
Total sales of electric energy .... million kilowatt-hours..	28,161.9	30,198.3	+7.2
Consumption for industrial purposes .... do....	16,552.0	16,969.0	+2.5
Foreign trade, Mobile Customs District:			
Value of exports .... millions..	[r] $494.4	$483.8	—2.1
Value of imports .... do....	$220.9	$269.2	+21.9

[p] Preliminary. [r] Revised.
Source: U.S. Department of Commerce; Bureau of Business Research, University, Ala.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	4,995	221	1,102	8,799	4	113	13.30	3,777
Metal	1,064	293	312	2,585	------	34	13.15	608
Nonmetal and native asphalt	771	272	210	1,695	------	24	14.16	404
Sand and gravel	513	270	139	1,259	------	22	17.47	1,998
Stone	2,572	283	729	6,012	3	55	9.65	3,061
Total [1]	9,915	251	2,491	20,350	7	248	12.53	2,931
1968: [p]								
Coal	5,000	219	1,096	8,658	9	99	12.47	6,935
Metal	930	297	284	2,338	------	22	9.41	1,011
Nonmetal and native asphalt	720	273	196	1,600	------	23	14.38	341
Sand and gravel	520	278	144	1,276	1	19	15.68	4,953
Stone	2,525	284	716	5,890	2	60	10.53	2,574
Total [1]	9,690	251	2,437	19,761	12	223	11.89	4,272

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Trends and Developments.—Alabama Power Co. continued installation of a 700,000-kilowatt generating unit at the Barry steamplant, located at Bucks, Mobile County. The $70 million unit will consume approximately 1.75 million tons of coal annually. A 350,000-kilowatt unit also under construction at the site will use about 875,000 tons of coal annually. The larger unit is scheduled to be operational in 1971, and the smaller unit in 1969.

A. P. Green Refractories Co. completed construction of a refractory brick plant near Eufaula.

Eufaula Bauxite Mining Co., a newly created company formerly known as the R. E. Wilson Mining Co., announced plans to expand mining of bauxite in the Eufaula area.

Holt Lock and Dam, on the Warrior-Tombigbee River System near Tuscaloosa, was dedicated. This was next to the last improvement needed to complete modernization of the locks of the Warrior-Tombigbee River System. The last phase, construction of the Bankhead Lock, will be completed in the next few years. When this lock is completed, lockage time for barges going from Birmingham to Mobile and back will have been cut from 125 hours in 1950 to 8 hours. A record 8.7 million tons moved over the river in 1967.

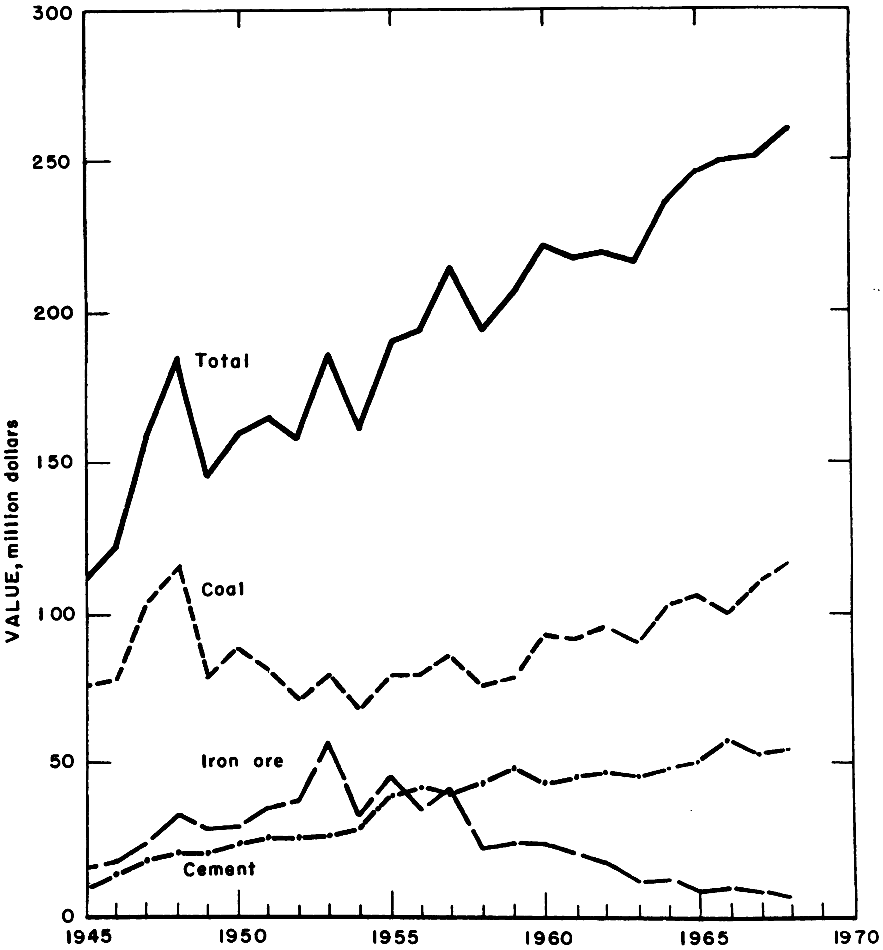

Figure 1.—Value of coal, cement, and iron ore, and total value of mineral production in Alabama.

McWane Cast Iron Pipe Co. at Mobile, Ala., received its first shipment of iron ore from West Africa. The plant will be the first in the United States to utilize a direct reduction process, in which pig iron is produced directly from iron ore without the use of blast furnaces, or other conventional iron-making facilities. It will use oystershell as flux instead of limestone. Completion of the facility is expected by early 1969.

Monsanto Co. leased the mineral rights to 72 acres in Limestone County to be included as part of the company's phosphate reserves. Plans for mining the phosphate are indefinite. The land is in the Gilbertsboro area near the Alabama-Tennessee State line.

Reynolds Metals Co. announced plans to build a reclamation plant for the conversion of scrap into secondary aluminum ingots near its alloys and reduction facilities at Listerhill, due to be completed by early 1969. The plant will recycle scrap generated by the company, as well as purchased scrap, for use at various company fabricating plants. Scrap will include "can scrap," derived from Reynolds pilot antilitter programs, in which the public collects all-aluminum cans and other packaging material.

Revere Copper and Brass Inc. completed a 90,000-ton-per-year aluminum rolling mill on Goose Pond Island near Scottsboro. A 112,000-ton-per-year reduction plant that can later be expanded to 336,000-ton-per-year is slated to be in operation by the company on the island by 1971. Alumina for the reduction plant will be imported from Jamaica.

Tennessee Valley Authority (TVA) announced plans to work with Farco Co., Inc., Fabius, Jackson County, in a study of a strip mine to open in 1970. The site is in Jackson County; about half of the acreage will be stripped to supply coal to TVA steamplants. TVA will install equipment to measure rainfall, streamflow, sediment accumulation, and water temperature and quality. The study will compare measurements taken before, during and after mining and after reclamation work is completed.

United States Gypsum Co. announced startup of a second kiln at its lime plant at Montevallo, Ala.

United States Steel Corp. began a multimillion-dollar program to improve water quality at its Fairfield Works, as part of a $30 million outlay for such facilities over the Nation.

Legislation and Government Programs.—The Bureau of Mines published three reports dealing with mineral resources in Alabama.[3] The Geological Survey of Alabama completed a lignite drilling program in southern Alabama. The program indicated that lignite deposits extend from western Wilcox County to the Mississippi State line. The thickness of the lignite, encountered in several hundred drill holes, ranged from 3 to 14 feet and averaged approximately 6 feet. The Survey also completed fieldwork on its first environmental geology study of the Florence-Sheffield-Tuscumbia area. The Survey published 18 reports dealing with geology and mineral and water resources, three geologic maps, and three water availability maps.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Mineral fuels accounted for 53 percent of the total value of the State's mineral production, compared with 52 percent in 1967.

Asphalt (Native).—Native asphalt (bituminous limestone) production decreased 34 percent. The decline in production was due to reduced local road construction in 1968. Alabama ranked third among the States in native asphalt production.

Coal (Bituminous).—Bituminous coal was produced from 142 mines in 12 counties. Production increased 6 percent and was at its highest level in 20 years. The increased output was due to increased demand by steam-generating powerplants. The leading producing counties were Jefferson, Marion, and Walker. The five leading producing companies supplied 49 percent of the State's total production. Average output per mine continued to increase and was 116,000 tons in 1968 compared with 99,000 tons in 1967. Captive tonnage made up 44 percent of the total production, compared with 46 percent in 1967. Fifty-six percent of the production was from underground mines and 44 percent from strip and auger mines. Eighty-one percent of the coal was shipped by rail and water and the remainder by truck. Seventy-one percent of the coal was cleaned at 22 cleaning plants.

Coke.—Metallurgical coke was produced by six companies at seven plants in Etowah, Jefferson, and Tuscaloosa Counties.

Natural Gas.—Marketed production of natural gas decreased 7 percent. Production was from two wells in the White House gasfield in Marion County.

Petroleum.—Production of crude petroleum increased 4 percent. Ten fields (including one new discovery) with 545 producing wells in five counties contributed to total production. The Citronelle field,

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[3] Adair, Ralph B., and James S. Browning. Flotation of Mica from Pegmatites of Randolph County, Ala. (BuMines Rept. of Inv. 7159, 1968, 11 pp.

Danielson, V. A., and D. H. White, Jr. Waste Disposal Costs at Two Coal Mines in Kentucky and Alabama. BuMines Inf. Circ. 8406, 1969, 28 pp.

Hollenbeck, Ronald P., and M. E. Tyrrell. Raw Materials for Lightweight Aggregate in Appalachian Region, Alabama and Georgia. BuMines Rept. of Inv. 7244, 1969, 21 pp.

Table 5.—Coal (bituminous) production[1] in 1968, by counties

(Thousand short tons and thousand dollars)

County	Number of mines and method of operation			Production				
	Underground	Strip	Auger	Underground	Strip	Auger	Total	
							Quantity[2]	Value
Jefferson	35	16	------	6,129	2,231	------	8,359	$64,267
Marion	25	3	------	W	W	------	498	2,365
Walker	9	16	2	2,189	[3] 2,132	(4)	4,321	30,857
Undistributed[5]	11	25	------	934	2,825	------	3,260	18,326
Total	80	60	2	9,252	[3] 7,188	(4)	16,440	115,815
Earliest record to date	NA	NA	NA	NA	NA	NA	1,073,211	NA

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Excludes mines producing less than 1,000 short tons.

[2] Data may not add to total shown because of independent rounding.

[3] Includes small quantity of auger tonnage.

[4] Included with strip tonnage.

[5] Includes Bibb, Blount, Cullman, Etowah, Fayette, Jackson, Shelby, Tuscaloosa, and Winston Counties.

Mobile County, with 411 producing wells was the leading field, followed by the Choctaw Ridge field, Choctaw County, with six wells; other producing fields were the Pollard field, Escambia County, with 30 wells; the Gilbertown field, Choctaw County, with 64 wells; the Toxey field, Choctaw County with six wells; the South Carlton field, Clarke and Baldwin Counties, with 19 wells; the Tensaw Lake field, Baldwin County, with four wells; the South Gilbertown field, Choctaw County, with three wells; the East Langsdale field, Choctaw County, with one well; and the Flomation field (new), Escambia County, with one well.

Table 6.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1967	1968
Baldwin	69	62
Choctaw	412	880
Clarke	119	116
Escambia	370	289
Mobile	6,379	6,288
Total[1]	7,348	7,635
Earliest record to date	89,318	96,953

[1] Data may not add to total shown because of independent rounding.

Source: State Oil and Gas Board.

Table 7.—Oil and gas well drilling

County	Drilling[1]					
	Development wells[2]		Exploratory wells[3]		Total	
	Oil	Dry	Gas	Dry	Wells	Footage
Choctaw	9	5	-------	6	20	185,363
Clarke	-------	-------	-------	4	4	21,459
Escambia	-------	-------	1	-------	1	15,383
Madison	-------	-------	-------	2	2	880
Washington	-------	-------	-------	2	2	34,589
Wilcox	-------	-------	-------	3	3	9,598
Total	9	5	1	17	32	267,272

[1] American Association of Petroleum Geologists.

[2] No gas development wells.

[3] No oil exploratory wells.

NONMETALS

Nonmetals accounted for 45 percent of the State's total value of mineral production, compared with 44 percent in 1967.

Cement.—Cement was produced by eight companies at 10 plants in six counties. Shipments of masonry cement increased 6 percent, and the State ranked third in the Nation in masonry cement production. Masonry production was by eight companies operating 10 plants in six counties. Leading producing counties were Jefferson, Mobile and St. Clair. Twenty-five percent of the masonry cement shipments had destinations in Alabama, and the remainder was shipped to the following States, in percent: Georgia 34; Florida 17; Louisiana 6; Mississippi 5; South Carolina 4; Virginia 4; Tennessee 3; and other States 2.

Seven companies produced portland cement at eight plants in five counties; shipments increased 1 percent above 1967 levels. The increase was due largely to higher demand for ready-mix concrete. Leading cement producing counties were Jefferson, Mobile, and Shelby. Thirty-seven percent of the shipments had Alabama destinations and the remainder was shipped, in percent, to Florida, 21; Georgia, 19; Mississippi, 8; South Carolina, 6; Louisiana, 3; Tennessee, 2; and other States, 4.

Sixty-one percent of the portland cement was used in ready-mixed concrete, 15 percent in the manufacture of concrete products, 12 percent by highway contractors, 6 percent by building material dealers, and 6 percent for other uses.

Slag cement was produced by two companies at two plants, one each in Jefferson and Blount Counties; shipments declined 8 percent.

Clay.—Fire clay was mined by seven companies at seven surface mines and one underground mine in five counties; total production decreased 7 percent. The value of production was $3.0 million, a decrease of 22 percent below that in 1967. Leading producing counties were Calhoun, St. Clair, and Walker.

Miscellaneous clay was mined by 18 companies at 24 surface mines in 13 counties; total production increased 7 percent. Increased output was due to the higher demands of the building industry. The leading producing counties for miscellaneous clay were Jefferson, Russell, and Shelby. Major uses were in the manufacture of heavy clay products, cement, and lightweight aggregate.

Table 8.—Fire clay sold or used by producers, by uses

(Short tons)

Use	1967	1968
Floor and wall tile	----------	714
Firebrick and block	235,390	W
Building brick	70,800	157,168
Vitrified sewerpipe	50,603	92,106
Other uses [1]	265,691	331,711
Total	622,484	581,699

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes mortar, foundries, saggers (1968), kiln furniture (1967), and steelworks (1967), and uses indicated by symbol W.

Alabama ranked third among the States in the production of kaolin. Two companies mined kaolin at surface mines in two counties; total production was below the 1967 level. Bentonite was mined by one company in Lowndes County; production was higher than in 1967 due to increased demand by the foundry industry.

Lime.—Five companies produced quicklime and hydrated lime at five plants in Shelby County and one company produced lime for use in the production of magnesium metal in Dallas County; total output increased 24 percent because of increased use for chemicals and agriculture. Fifty-five percent of shipments were made to destinations in Alabama; other shipments, in percent, were made to Florida, 15; Georgia, 12; Tennessee, 8; Mississippi, 4; and other States, 6.

Quicklime was recovered as a byproduct by nine companies operating 10 papermills.

Table 9.—Lime sold or used by producers, by uses

(Short tons)

Use	1967	1968
Construction	104,601	110,163
Steel electric furnaces	25,011	22,740
Paper	204,825	228,927
Sewage	22,379	50,214
Sugar refining	3,535	W
Water purification	51,983	53,487
Other uses [1]	211,928	306,998
Total	624,262	772,529

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes lime used for agriculture; alkalies; brick, sand-lime, and slag (1967); calcium carbide, coke, food, insecticides, magnesia (1968), basic oxygen convertors (1968), open-hearth furnace (1968), metallurgical uses, paint (1967), petroleum, tanning (1968), other uses, and use indicated by symbol W.

Mica.—Scrap mica was produced by one company operating two mines in Randolph County; production increased 63 percent. Alabama ranked second among the States in the production of scrap mica.

Salt.—One company produced salt in brine in Washington County for manufacture of chemicals; production increased 8 percent.

Sand and Gravel.—Fifty-one commercial and three Government-and-contractor operations mined sand and gravel in 30 counties. Production increased 13 percent, due primarily to increased use in road paving. Leading producing counties were Clarke, Macon, and Montgomery. Forty stationary plants, seven portable plants, and 19 dredges were in operation during the year. Virtually the entire production was processed by washing. Of the total commercial production, 61 percent was shipped by truck, 31 percent by rail, and 8 percent by water. Twenty-two operations had annual outputs of over 100,000 tons and accounted for 82 percent of total production. The major uses of the sand and gravel were for building, paving, and fill.

Stone.—Limestone was mined and crushed at 44 commercial and one Government-and-contractor operation in 19 counties. Production increased 12 percent due to increased uses in concrete and roads, the manufacture of cement, and agricultural stone (agstone). Leading producing counties were Jefferson, Morgan, and Shelby.

Dimension limestone was quarried by one company at an underground mine in Franklin County. Production was slightly higher than 1967 due to increased demand for exterior building stone.

Three companies crushed and ground marble in Talladega County. Production increased 11 percent due to increased demand for fillers and whiting.

Dimension marble was quarried by one company in Talladega County. Major uses for the marble were dressed building and dressed monumental stone. Production was below 1967 due primarily to less demand for rough building stone.

Oystershell was dredged from Mobile Bay by two companies; production increased 12 percent due to increased use in road construction and the manufacture of cement.

Sandstone was quarried and crushed by three companies at three mines in two counties. Major use for the sandstone was fluxing stone, followed by use in the manufacture of cement. Production was higher than the 1967 level.

Table 10.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1967			1968		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Autauga	1	343	$299	1	W	W
Cherokee	1	2	W	2	W	W
Coffee	1	50	50	1	W	W
Crenshaw	1	9	W	1	9	W
Elmore	1	436	W	1	437	W
Escambia	4	573	522	4	488	$570
Etowah	2	W	W	3	159	223
Fayette	1	W	W	1	79	W
Hale	1	2	2	2	26	W
Macon	3	636	796	3	648	918
Marion	1	21	51	-------	-------	-------
Marshall	2	W	W	1	80	140
Monroe	1	38	34	1	45	62
Montgomery	5	2,079	1,987	5	2,248	1,776
Talladega	1	170	249	2	W	W
Tuscaloosa	5	265	310	3	W	W
Other counties [1]	19	2,605	3,669	23	3,921	5,441
Total	50	7,299	7,969	54	8,140	9,130

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."

[1] Includes Baldwin (1968), Barbour, Bibb, Chilton, Clarke, Dale (1968), Dallas, Francklin, Geneva, Greene (1967), Houston, Marengo (1968), Mobile, Morgan, Russell, Sumter Counties, and counties indicated by symbol W.

Table 11.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967			1968		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	2,274	$2,233	$0.98	2,306	$2,439	$1.06
Paving	644	625	.97	916	933	1.02
Fill	53	22	.42	68	22	.32
Other sands [1]	327	467	1.43	412	679	1.65
Total	3,298	3,347	1.01	3,702	4,073	1.10
Gravel:						
Structural	2,286	2,929	1.28	2,219	2,996	1.35
Paving	748	864	1.16	1,209	1,354	1.12
Miscellaneous gravel	207	256	1.24	W	W	W
Other gravel [2]	690	573	.83	1,010	707	.70
Total	3,931	4,622	1.18	4,438	5,057	1.14
Total sand and gravel	7,229	7,969	1.10	8,140	9,130	1.12

W Withheld to avoid disclosing individual company confidential data.

[1] Includes railroad ballast (1968), fire-furnace (1968), engine, molding, and other sands.

[2] Includes railroad ballast (1968), fill and other gravel, and use indicated by symbol W.

Table 12.—Crushed limestone sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1967			1968		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Colbert	4	1,040	$1,311	3	1,125	$1,339
Cullman	1	66	104	--------	--------	--------
Jackson	1	130	W	1	W	W
Jefferson	9	4,144	5,187	9	4,154	5,310
Lee	1	328	W	1	W	W
Limestone	1	47	70	1	46	70
Madison	4	1,300	1,272	4	1,462	1,439
Morgan	5	W	W	4	2,116	2,614
Shelby	9	4,339	6,033	9	4,653	6,225
Other counties [1]	14	5,117	6,591	13	4,905	6,095
Total [2]	49	16,511	20,567	45	18,460	23,092

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."

[1] Includes Bibb, Calhoun, Covington, De Kalb, Etowah, Franklin, Henry (1967), Marengo, Marshall, St. Clair, Talladega, and Washington Counties, and counties indicated by symbol W.

[2] Data may not add to totals shown due to independent rounding.

Table 13.—Crushed limestone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967			1968		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roads	8,787	$10,887	$1.24	10,629	$13,233	$1.24
Cement manufacture	3,833	2,969	.77	3,958	3,111	.79
Lime manufacture	1,045	1,709	1.64	1,126	1,948	1.73
Fluxing stone	995	1,674	1.68	724	1,176	1.62
Agstone	840	1,382	1.65	985	1,599	1.62
Riprap	W	W	W	385	573	1.49
Railroad ballast	W	W	W	89	114	1.28
Other uses [1]	1,013	1,945	1.92	564	1,339	2.37
Total [2]	16,511	20,567	1.25	18,460	23,092	1.25

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes metallurgical (1968), refractory stone, chemical stone (1968), alkali (1967), paper, asphalt and fertilizer (1967) and other (1968) fillers, rock dust for coal mines, mineral food, magnesium metal, dolomite terrazo, poultry grit, and other uses.

[2] Data may not add to totals shown because of independent rounding.

Talc.—One company mined and ground talc in Talladega County for toilet preparations, paint, and other uses.

METALS

Bauxite.—Alabama ranked second among the States in the production of bauxite. Five companies mined crude bauxite in Barbour and Henry Counties. Production increased 22 percent due to increased demand for bauxite by the chemical and refractory industries.

Iron and Steel.—Production of pig iron was 4.5 million tons valued at $245 million, compared with 4.3 million tons valued at $235 million in 1967. Twelve of 19 blast furnaces were operated during the year.

Iron Ore.—Usable iron ore shipments continued to decrease and were 22 percent below the 1967 level. Seven mines produced iron ore, compared with 15 mines in 1967. The decline in shipments and number of operating mines was due primarily to the continued increase in consumption of foreign ores. Consumption of iron ore at agglomerating plants, blast furnaces, and steel furnaces in the State was 34 percent domestic ore and 66 percent foreign ore, compared with 40 percent and 60 percent respectively in 1967.

One company mined red iron ore at its underground mine in Jefferson County and one company shipped red iron ore from stockpiles in Tuscaloosa County. Five companies mined brown iron ore at six surface

Table 14.—Mine production and shipments of crude iron ore

	1967		1968	
	Number of mines	Long tons (thousands)	Number of mines	Long tons (thousands)
Mine production:				
By varieties:				
Hematite	1	1,036	1	1,078
Limonite	14	2,638	6	1,251
By mining methods:				
Open pit	14	2,638	6	1,251
Underground	1	1,036	1	1,078
Shipments from mines:				
Direct to consumers	1	201	1	148
To beneficiation plants	14	3,402	8	2,006

Table 15.—Usable iron ore production and shipments

	1967		1968	
	Long tons (thousands)	Iron content, natural (percent)	Long tons (thousands)	Iron content, natural (percent)
Production:				
Hematite	877	34	914	35
Limonite	751	46	411	47
Shipments:				
Direct-shipping ore	201	34	148	32
Concentrates and sinter	1,271	40	1,003	39
Total shipments	1,472	----	1,151	----

mines in five counties, and one company shipped from stockpile in Shelby County; usable production decreased 45 percent. Principal producing counties were Blount, Franklin, and Pike. Of the total usable iron ore shipments, 13 percent was direct-shipping ore compared with 14 percent in 1967.

Imports of iron ore, chiefly from Venezuela, were 11 percent below 1967 levels.

Magnesium.—One company produced magnesium metal at its plant near Selma, Dallas County, from dolomite mined near Montevallo, Shelby County.

Table 16.—Usable iron ore shipments, by counties

(Thousand long tons and thousand dollars)

County	1967			1968		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Butler	3	W	W	1	8	$44
Jefferson	1	799	W	1	711	W
Pike	3	124	$649	1	W	W
Tuscaloosa	-------	-------	-------	1	18	W
Other counties [1]	8	549	7,637	5	414	6,686
Total	15	1,472	8,286	9	1,151	6,730

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."

[1] Includes Barbour, Blount, Crenshaw (1967), Franklin, and Shelby Counties, and counties indicated by symbol W.

Table 17.—Principal producers

Commodity and company	Address	Type of activity	County
Alumina: Aluminum Co. of America.	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	Plant	Mobile.
Aluminum smelters: Reynolds Metal Co.	Reynolds Metals Bldg. Richmond, Va. 23218	do	Colbert.
Asphalt (native): Southern Stone Co., Inc. [1]	2111 8th Ave. South Birmingham, Ala. 35223	Quarry	Do.
Bauxite:			
Eufaula Bauxite Mining Co.	Box 556 Eufaula, Ala. 36027	Open pit mine and plant	Barbour.
General Refractories Co.	Abbeville, Ala. 36310	Open pit mine	Henry.
A. P. Green Refractories Co.	Box 608 Eufaula, Ala. 36027	Open pit mine and plant	Barbour.
Harbison-Walker Refractories Co.	1800 Farmers Bank Bldg. Pittsburgh, Pa. 15222	do	Henry.
Wilson-Snead Mining Co.	Box 84 Eufaula, Ala. 36027	2 open pit mines	Barbour and Henry.
Cement:			
Ideal Cement Co. [2]	420 Denver National Bldg. Denver, Colo. 80202	Plant	Mobile.
Lone Star Cement Corp.[2]	Box 6237 West End Branch Richmond, Va. 23230	2 plants	Jefferson and Marengo.
National Cement Co.[2]	Box 3358 Birmingham, Ala. 35205	Plant	St. Clair.
Southern Cement Co. [3]	Bank for Savings Bldg. Birmingham, Ala. 35205	2 plants	Jefferson and Shelby.
United States Steel Corp. [4]	Box 2969 Pittsburgh, Pa. 15230	do	Jefferson.
Clay:			
Bentonite: American Colloid Co.	5100 Suffield Court Skokie, Ill. 60076	Open pit mine	Lowndes.
Fire:			
Dixie Clay Co.	Box 361 Anniston, Ala. 36202	do	Calhoun.
Donoho Clay Company.	Box 843 Anniston, Ala. 36202	do	Do.
Glen-Gery Corp.	Box 1542 Reading, Pa. 19603	Underground mine	Walker.
Marigold Coal, Inc.	Jasper, Ala. 35501	Open pit mine	Do.
Riverside Clay Co.	Box 551 Pell City, Ala. 35125	do	St. Clair.

See footnotes at the end of the table.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clay—Continued			
Kaolin:			
Harbison-Walker Refractories Co.	1800 Farmers Bank Bldg. Pittsburgh, Pa. 15222	2 open pit mines and plant	Henry.
Thomas Alabama Kaolin Co.	2412 Ken Oak Road Baltimore, Md. 21209	Open pit mine	Marion.
Miscellaneous:			
Bickerstaff Clay Products Co., Inc.	Box 1178 Columbus, Ga. 31902	4 open pit mines	Jefferson and Russell.
Jenkins Brick Co.	Box 91 Montgomery, Ala. 36101	2 open pit mines	Elmore and Montgomery.
Southern Cement Co.	Bank for Savings Bldg. Birmingham, Ala. 35203	do	Shelby.
Vulcan Materials Co.	Box 7324-A Birmingham, Ala. 35223	Open pit mine and plant	Jefferson.
Coal:			
Alabama By-Products Corp.	Box 354 Birmingham, Ala. 35202	2 under- mines ground and plant	Do.
Peabody Coal Co.	301 North Memorial Drive St. Louis, Mo. 63102	2 strip mines	Jefferson and Walker.
Southern Electric Generating Co.	600 North 18th St. Birmingham, Ala. 35203	2 underground mines	Shelby and Walker.
United States Steel Corp.	Box 599 Fairfield, Ala. 35064	Underground mine and plant	Jefferson.
Woodward Co.	Woodward, Ala. 35189	2 underground mines and plants	Do.
Coke:			
Alabama By-Products Corp.	Box 6527 Tarrant, Ala. 35217	Plant	Jefferson.
Republic Steel Corp.	25 Prospect Ave., N.W. Cleveland, Ohio 44115	do	Etowah.
U.S. Pipe & Foundry Co.	Box 2651 Birmingham, Ala. 35212	do	Jefferson.
Woodward Co.	Woodward, Ala. 35189	do	Do.
Iron ore:			
Hematite: Woodward Co.	do	Underground mine	Do.
Limonite:			
Shook & Fletcher Supply Co.	Box 2631 Birmingham, Ala. 35202	2 open pit mines	Blount and Franklin.
U.S. Pipe & Foundry Co.	Box 2651 Birmingham. Ala. 35212	Open pit mine	Franklin.
Lime:			
Primary:			
Alabama Metallurgical Corp.	Box 340 Selma, Ala. 36702	Limekiln and plant	Dallas.
Alabaster Lime Co.	Siluria, Ala. 35144	do	Shelby.
Longview Lime Co.	Woodward, Ala. 35189	do	Do.
Southern Cement Co.	Bank for Savings Bldg. Birmingham, Ala. 35203	do	Do.
United States Gypsum Co.	101 South Wacker Drive Chicago, Ill. 60606	Limekiln and plant	Do.
Regenerated:			
American Can Co.	Box 315 Butler. Ala. 36904	Rotary kiln	Choctaw.
Gulf States Paper Corp.	Tuscaloosa, Ala. 35401	2 rotary kilns	Marengo and Tuscaloosa.
International Paper Co.	Mobile, Ala. 36601	Rotary kiln	Mobile.
Kimberly-Clark Corp.	Coosa Pines, Ala. 35044	do	Talladega.
Scott Paper Co.	Mobile, Ala. 36601	do	Mobile.
Magnesium smelters: Alabama Metallurgical Corp.	Box 340 Selma, Ala. 36702	Plant	Dallas.
Mica, scrap: United States Gypsum Co.	101 South Wacker Drive Chicago, Ill. 60606	Open pit mine and plant.	Randolph.
Natural gas: Black Warrior Petroleum Co., Inc.	Box 1642 Mobile, Ala. 36601	Gasfield	Marion.
Petroleum:			
Crude:			
Ancora Corporation	One Jackson Place, Suite 620 San Francisco, Calif. 94111	Citronelle field.	Mobile.

See footnotes at the end of the table.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Petroleum, Crude—Continued			
Chesley Pruet Drilling Co.	Box 31 El Dorado, Ark. 71730	Choctaw Ridge field	Choctaw.
Humble Oil Refining Co.	Box 2180 Houston, Tex. 77001	East Langsdale field, Gilbertown field, Pollard field,	Choctaw and Escambia.
Mobil Oil Corporation	Box 900 Dallas, Tex. 75221	Citronelle field	Mobile.
Sun Oil Company	Box 2880 Dallas, Tex. 75221	do	Do.
Refineries:			
Alabama Refining Co	Mobile, Ala. 36600	Plant	Do.
Chevron Asphalt Co	do	do	Do.
Hunt Oil Co	Tuscaloosa, Ala. 35401	do	Tuscaloosa.
Vulcan Asphalt Refining Co.	Cordova, Ala. 35550	do	Walker.
Warrior Asphalt Co	Tuscaloosa, Ala. 35401	do	Tuscaloosa.
Pig iron:			
Republic Steel Corp	1629 Republic Bldg. Cleveland, Ohio 44115	Blast furnaces and mills	Etowah and Jefferson.
U.S. Pipe & Foundry Co	Box 2651 Birmingham, Ala. 35212	Blast furnaces and mills.	Jefferson.
United States Steel Corp	Box 599 Fairfield, Ala. 35064	do	Do.
Woodward Co	Woodward, Ala. 35189	do	Do.
Salt: Olin Mathison Chemical Corp.	Box 28 McIntosh, Ala. 36553	Brine wells	Washington.
Sand and gravel:			
Alabama Gravel Co	2325 City Federal Bldg. Birmingham, Ala. 35203	Dredge	Elmore.
Radcliff Materials Inc	Mobile, Ala. 36601	do	Mobile.
W. T. Ratliff	Jackson, Ala. 36545	Open pit mine	Clarke.
C. T. Thackston Sand & Gravel Co.	Box 3211 Mongomery, Ala. 36101	do	Montgomery.
Vulcan Materials Co	Box 7324–A Birmingham, Ala. 35223	2 open pit mines	Macon and Montgomery.
Stone:			
Limestone, crushed:			
Dolcito Quarry Co	Box 6566 Birmingham, Ala. 35217	Quarry	Jefferson.
Lone Star Cement Corp	Box 6237 West End Branch Richmond, Va. 23230	3 quarries	Jefferson, Marengo, and Washington.
Southern Cement Co	Bank for Savings Bldg. Birmingham, Ala. 35203	Quarry	Shelby.
Southern Stone Co., Inc.	2111 8th Ave. South Birmingham, Ala. 35223	3 quarries	Colbert, Jefferson, and Shelby.
Vulcan Materials Co	Box 7324–A Birmingham, Ala. 35223	6 quarries	Colbert, Etowah, Franklin, Madison, Shelby, and Talladega.
Limestone, dimension:			
Georgia Marble Co	Russellville, Ala. 35653	Quarry	Franklin.
Marble, crushed:			
Georgia Marble Co	Gantts Quarry, Ala. 35069	2 quarries	Talladega.
Moretti-Harrah Marble Co.	Box 330 Sylacauga, Ala. 35150	Quarry and plant	Do.
Thompson-Weinman & Co.	Cartersville, Ga. 30120	Quarry	Do.
Marble, dimension: Moretti-Harrah Marble Co.	Box 330 Sylacauga, Ala. 35150	Quarry and plant	Do.
Oystershell:			
Radcliff Materials, Inc.	Mobile, Ala. 36601	Dredge	Mobile.
Southern Oyster Shell Mining Corp.	Box 1288 Mobile, Ala. 36601	Plant	Do.
Sandstone, crushed:			
Dallas Sand & Gravel Co.	2196 Water Ave. Selma, Ala. 36701	Quarry	Dallas.
Enos Vann	Box 246 Trussville, Ala. 35173	do	Jefferson.
Talc: American Talc Co	Alpine, Ala. 35014	Open pit mine and plant	Talladega.

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[1] Asphaltic limestone.
[2] Portland and masonry cement.
[3] Portland, masonry, and slag cement.
[4] Portland, masonry, and also miscellaneous clay, coke, and sandstone.

The Mineral Industry of Alaska

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Division of Mines and Geology of the Alaska Department of Natural Resources, for collecting information on all minerals.

By Kevin Malone,[1] Donald P. Blasko,[2] and James A. Williams[3]

Oil again made the headline news in the mineral industry of Alaska in 1968. Discoveries at Prudhoe Bay on the Beaufort Sea in far northern Alaska and at Sagavanirktok River 7 miles to the south, confirmed Alaska's status as a major petroleum province on a national and world basis. The discoveries overshadowed a spectacular increase in crude oil production. Alaska crude, which had increased more than 100 percent in 1967, again increased more than 100 percent in physical volume and value in 1968.

Total value of mineral production in 1968 was $221.7 million, an increase of 65 percent over the figure for 1967. Crude oil and natural gas production, $186.7 million and $4.4 million respectively, made up 86 percent of the total. Value of sand and gravel, the State's second-place mineral commodity, decreased from $26.2 million to $20.4 million. Tonnage produced was 18.0 million versus 22.4 million tons in 1967. Both tonnage and value of coal decreased appreciably, reflecting the changeover of the Anchorage military bases from coal to natural gas for fuel and power

Table 1.—Mineral production in Alaska[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrate..short tons, antimony content..	10	W	3	W
Barite..............thousand short tons..	W	W	91	W
Coal (bituminous)..............do....	925	$7,296	750	$4,502
Gold (recoverable content of ores, etc.)..........troy ounces..	22,948	803	21,262	[2] 835
Lead (recoverable content of ores, etc.)..........short tons..	-------	--------	W	W
Natural gas..............million cubic feet..	14,438	3,610	17,348	4,388
Peat..............short tons..	1,528	12	--------	---------
Petroleum (crude)..............thousand 42-gallon barrels..	29,126	91,164	66,204	186,695
Sand and gravel..............thousand short tons..	22,370	26,248	18,013	20,366
Silver (recoverable content of ores, etc.)..thousand troy ounces..	6	9	4	8
Value of items that cannot be disclosed: Copper, gem stones, mercury, platinum-group metals, stone, tin and values indicated by symbol W..............	XX	4,924	XX	4,923
Total..............	XX	134,066	XX	221,717
Total 1957-59 constant dollars..............	XX	r 130,464	XX	p 213,674

p Preliminary. r Revised. W Withheld to avoid disclosing individual company confidential data.
XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Based on average U.S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968, and the New York selling price for the remainder of the year.

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[3] Director, Division of Mines and Geology, Department of Natural Resources, State of Alaska, College, Alaska.

Table 2.—Value of mineral production in Alaska, by region [1]

(Thousands)

Region	1967	1968	Minerals produced in 1968 in order of value
Alaska Peninsula	--------	W	Sand and gravel.
Aleutian Islands	$33	W	Stone, sand and gravel.
Bristol Bay	1	W	Sand and gravel.
Cook Inlet-Susitna	66,233	$154,802	Petroleum, sand and gravel, stone, coal, gold, gem stones, silver.
Copper River	4,255	3,869	Sand and gravel, stone, copper, silver, gold.
Kenai Peninsula	47,266	44,203	Petroleum, natural gas, sand and gravel, stone.
Kodiak	20	W	Sand and gravel.
Kuskokwim	1,019	1,178	Platinum-group metals, gold, mercury, gem stones, silver.
Northern Alaska	59	W	Sand and gravel.
Northwestern Alaska	7	129	Gem stones, sand and gravel.
Seward Peninsula	61	97	Gold, tin, gem stones, silver.
Southeastern Alaska	4,710	5,320	Sand and gravel, stone, barite, gold, silver.
Yukon River	10,402	11,480	Sand and gravel, coal, gold, stone, gem stones, silver, antimony, copper, lead.
Total	184,066	221,717	

W Withheld to avoid disclosing individual company confidential data; included in "Total".

[1] No production reported in the Bering Sea region.

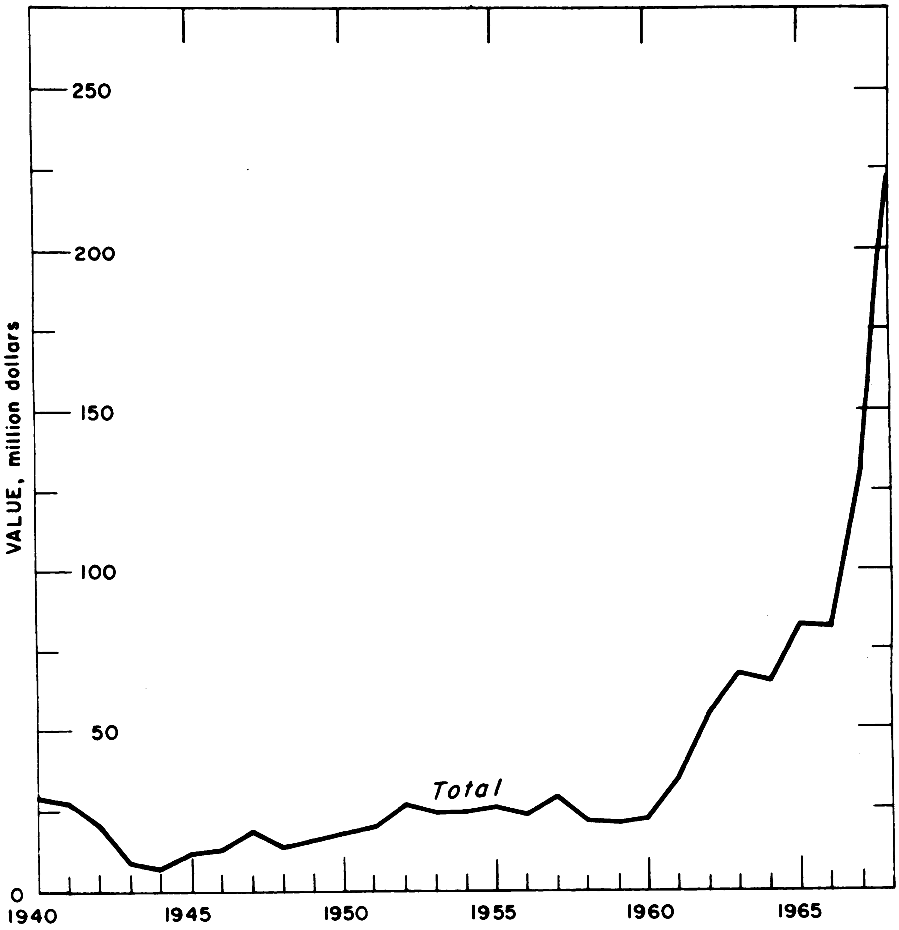

Figure 1.—Total value of mineral production in Alaska.

Table 3.—Indicators of Alaska business activity

	1967	1968 p	Change (percent)
Employment and labor force, annual average:			
Total labor force...thousands	94.0	100.1	+6.5
Unemployment...do	8.3	9.1	+9.6
Employment:			
Construction...do	5.8	6.0	+3.4
Aerospace [1]...do	2.1	2.5	+19.0
Lumber and wood products...do	2.4	2.5	+4.2
Food processing...do	2.8	3.3	+17.9
All manufacturing...do	6.1	6.9	+13.1
All industries...do	85.7	91.0	+6.2
Factory payrolls...millions	$55.9	$63.3	+13.2
Personal income:			
Total...do	$897.0	$1,130.0	+26.0
Per capita	$3,629.0	$4,124.0	+13.6
Construction:			
Payroll...millions	$95.8	$100.1	+4.5
Highway work completed...do	$44.2	$52.1	+17.9
Gross business receipts:...do	$1,506.4	$1,555.3	+3.2
Construction...do	$325.9	$352.2	+8.1
Retail sales...do	$489.1	$514.3	+5.1
Manufacturing...do	$93.0	$100.9	+8.5
Resource production:			
Agriculture...do	$5.5	$5.5	----------
Fisheries...do	$132.5	$217.5	+64.1
Forest products...do	$77.7	$91.0	+17.1
Mineral...do	$134.1	$221.7	+65.3
Utility sales...million kilowatt-hours	786.0	NA	NA
Foreign trade:			
Exports...millions	$47.4	$55.3	+16.7
Imports...do	$11.6	$23.7	+104.3
Population:...thousands	279.0	284.9	+2.1
Civilian...do	247.0	252.3	+2.1
Military...do	32.0	32.6	+1.9

p Preliminary. NA Not available.

[1] Air transportation.

Sources: Survey of Current Business, State Department of Labor, Agricultural Crop and Livestock Reporting Service, State Department of Highways, State Department of Revenue, State Department of Economic Development.

requirements. Gold, for so many years the mainstay of the State's mineral economy, again decreased in physical volume. Value, under the open market arrangements permitted by the two-price system, increased 4 percent. Unit value was $39.26 per troy ounce compared with the $35 price in effect since 1935.

Legislation and Government Programs.—The Alaska Power Administration (APA), created by the Secretary of the Interior in mid-1967 to take over the duties and functions of the Bureau of Reclamation in Alaska, completed its first full year of operation. APA focused major efforts on the proposed Yukon-Taiya project to dam the waters of the upper Yukon in northern British Columbia and lead them through the Coast Range by means of a 17-mile tunnel to a generating site on tidewater at Skagway. Under a 2,000-foot head, Yukon-Taiya would develop 700,000 kilowatts in the initial stage with an ultimate capacity of 4 million kilowatts possible. Ultimate energy output of 25 billion kilowatt-hours per year would exceed that of Grand Coulee Dam.

At yearend, an agreement was announced between the Governments of Canada and the United States to exchange information on the power market potential of possible future hydroelectric developments in the area of the Upper Yukon watershed. An initial study, scheduled for completion late in 1969 will focus on the power market potential premised on availability of hydroelectric power at 3 to 4 mills per kilowatt-hour. The Department of Energy, Mines and Resources in cooperation with the Department of Lands, Forests and Water Resources of the Province of British Columbia will coordinate the study in Canada with APA responsible for United States participation.

The Federal Field Committee for Development Planning in Alaska, charged with making or fostering surveys and studies to provide data for a program on economic and resources development, released a number of reports during the year.[4]

Recognizing the importance of settlement of the Native land claims, the Field Committee made a major study of this problem and reported in Alaska Native Claims: Major Elements of a Proposed Settlement. The report was intended for use by the Congress in enacting legislation for an equitable solution of claims of Native Alaska peoples against the Federal Government. The Field Committee released the comprehensive study, Alaska Natives and the Land, late in the year. The massive work was expected to have a major impact on the development of the necessary legislation to settle the Native land claims.

Under a contract awarded by the U.S. Army Corps of Engineers, the Mineral Industry Research Laboratory of the University of Alaska prepared and released a report.[5] The study contained excellent maps of mineral occurrences by commodity and of patented claims, active mineral claims, and inactive claims.

The University's Mineral Industry Research Laboratory also issued a report on the mineral resources of Northern Alaska.[6] Sponsored by the North Commission, a State agency, the study was intended to bring together information on the mineral resources and geology of the northern area, to delineate potentially favorable areas for exploration, and to investigate mineral policy ideas for the development of the area.

Work on the Snettisham hydroelectric project, 28 miles southeast of Juneau, continued throughout the year with first-phase work near completion. Ancillary road, airstrip, dock and camp facilities were largely finished. Excavation for the powerhouse, damsite, and surge tank adit were underway. The plus 600-foot diversion tunnel to drain Long Lake while the dam was under construction was advanced to within 9 feet of target; blasting of this plug was awaiting installation of an outlet gate to control draining of Long Lake.

Bids for second phase work at Snettisham, valued at more than $10 million, were scheduled for early 1970. The contract called for construction of a concrete gravity dam, plugging the diversion tunnel, and various tunnels in connection with transport of power. Snettisham power was expected to come on the line late in 1972 at a rate of 46,700 kilowatts in the first phase; with subsequent construction of the Crater Lake tap, capacity was estimated at 70,000 kilowatts. Discarding original plans for a conventional overland alternating current (ac) transmission line, the Corps and APA announced the decision to use two 45-mile direct current (dc) submarine cables in a pioneering installation. The dc transmission was made feasible by innovations in the use of solid-state conversion equipment from ac to dc and back to ac.

Preparations for the sale of the Federally owned Alaska Communications System (ACS) continued throughout the year. The 1967 Congress had authorized the sale of the nonmilitary sections of the system to private industry. The U.S. Air Force, operator of the system since 1962, was handling negotiations for the Federal Government. In October, invitations to bid were issued with the bid deadline March 1, 1969, and the target date for private industry takeover July 1, 1969. A total price of $30 million for the physical properties of ACS was set. Late in the year representatives of prospective bidders met with Federal and State officials to discuss requirements of a transfer to private ownership. Major U.S. communication companies had representatives at the meeting.

Communications Satellite Corp. (Comsat), after extensive investigations early in the year, announced plans for a standard satellite earth station to link Alaska communications facilities with West Coast States and with Canada and the countries of the Far East. At midyear, Comsat submitted a land lease application to the State Division of Lands for 320 acres 3 miles east of Talkeetna. At yearend Comsat filed an application with the Federal Communications Commission for permission to build a ground station at Talkeetna and a microwave ground link from the station to Anchorage, 90 miles to the south. Cost of the Talkeetna installation, estimated to require about 22 months to build, was put at $6.3 million. The microwave link to Anchorage, and ancillary equipment, were estimated at about $1 million.

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[4] Federal Field Committee for Development Planning in Alaska. Alaska Natives and the Land. 1968, 565 pp.

Jones, D. W., A. R. Tussing, and others. A Subregional Economic Analysis of Alaska. 1968, 388 pp.

Tussing, A. R., and G. R. Erickson. Mineral Policy, The Public Lands and Economic Development: The Case for Alaska. 1968, 163 pp.

Tussing, A. R., and others. Alaska Japan Economic Relations. 1968, 466 pp.

[5] Lu, F. C. J., L. E. Heiner, and D. P. Harris. Known and Potential Mineral Resources, Seward Peninsula, Alaska. Part I, Known Mineral Resources, Production, and Occurrences. Part II, Potential Mineral Resources of Seward Peninsula, Alaska. An evaluation by Geostatistics and Computer Simulation. September 1968, 107 pp.

[6] Heiner, L. E. and E. N. Wolff. Mineral Resources of Northern Alaska. June 1968, 299 pp.

The U.S. Atomic Energy Commission (AEC) continued with the development of the Amchitka test site in the Rat Islands far out along the Aleutian Chain. A $1.17 million contract for an additional, 300-man camp was awarded; the new camp raised to 1,000 the housing capacity of the project. Amchitka was the site for conducting underground nuclear tests at yields higher than those feasible at the Commission's Nevada test site. AEC also announced bids on a contract to mine a large cavity at the bottom of a drilled shaft at Amchitka. The shaft was 6,000 feet deep with an inside-casing diameter of 54 inches. The cavity at the bottom was to be 30 feet in diameter and 61 feet high. Amchitka facilities were expected to be ready for a site proof test in the first half of 1969.

In a court action brought by the State of Alaska, a U.S. District judge in Anchorage ruled that the Secretary of the Interior's 2-year land freeze on Federal lands was illegal and ordered it lifted. The freeze had been ordered after the 1966 filings by Native groups claiming huge tracts under aboriginal rights. Interior appealed the ruling. Pending a decision on the appeal, the Secretary late in the year authorized the Bureau of Indian Affairs (BIA) to file a withdrawal application on all vacant and unappropriated Federal land in Alaska—some 260 million acres. The BIA action was intended to preserve the status quo until the Congress could act to settle the Native land claims controversy. Filings of metalliferous mining claims were exempted from the law authorizing Federal agencies to apply for land withdrawals.

Wages and Hours.—Total insured wages in the mineral industries in the calendar year 1968, as reported by the Alaska Department of Labor, were $38.0 million ($28.4 million in 1967). Average monthly employment was 2,452 (1,967) with 154 (130) units reporting. In the mineral industries covered by the Employment Securities Act (operators with hired labor), monthly earnings averaged $1,293 compared with $1,206 in 1967. Monthly earnings in metal mining were $876, in nonmetal mining, $1,140; in coal mining, $1,225; and in oil and gas including production and exploration, $1,327. The figures for 1967 were $804, $892, $1,163, and $1,259 respectively. Special conditions, including excessive overtime, in one classification were responsible for most of the large increase in nonmetallic mining wages. Because of regulations on confidentiality, the State Division of Employment Security was not permitted to release detailed information.

Transportation.—In preliminary reports to Alaska's governor, the Northern Operations of Rail Transportation and Highways Commission (NORTH), created by the 1967 Legislature, recommended extension of the Alaska Railroad to the North Slope. The Commission, viewing the extension as a 5-year, $200 million project, sought Federal funds for a detailed engineering study to determine a final route selection and firm cost estimates.

Proponents of the railroad were hopeful no new act of Congress would be needed—pointing out that the original act authorized construction of 1,000 miles of line with only 500 miles built so far. Congressional appropriations would be necessary, however, if Federal funds were to be used for the construction. The Department of Defense, in initial investigations, completed aerial photography on a 200-mile stretch of the proposed extension between Dunbar, southwest of Fairbanks, and the Melozitna River to the northwest. Snow cover prevented the aerial survey on north to Umiat on the Colville River.

Pending developments in extension of the railroad to the north, State officials determined that a temporary winter haul road was necessary to expedite orderly development of the North Slope oil discoveries. By yearend the State Department of Highways had completed a 60-mile section of the road between Livengood, northwest of Fairbanks and Stevens Village on the Yukon River. The 350-mile section north of Stevens Village was to be routed through Bettles and Anaktuvuk Pass to either Umiat or Sagwon south of Prudhoe Bay. Ice bridges were to be used for crossing the Yukon and the Koyukuk Rivers.

In a court action to determine jurisdiction on through rates established between water and motor carriers, the 9th Circuit

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal and peat	137	276	38	321	1	24	77.95	19,251
Metal	270	162	44	369	1	6	18.98	16,794
Nonmetal	15	81	1	11	------	1	91.83	275
Sand and gravel	766	204	156	1,406	------	15	10.67	267
Stone	150	160	24	195	------	5	25.69	678
Total[1]	1,338	197	263	2,301	2	51	23.04	5,598
1968:[p]								
Coal and peat	135	281	37	315	------	23	72.96	511
Metal	235	128	30	260	1	7	30.80	27,089
Nonmetal	20	160	3	25	1	2	118.18	237,975
Sand and gravel	685	195	133	1,181	------	28	23.71	522
Stone	115	125	14	115	------	2	17.34	564
Total[1]	1,185	184	218	1,897	2	62	33.74	7,339

[p] Preliminary.

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Expenditures by major companies for exploration, prospecting, and development

(Thousands)

Type and region	1967	1968
Metals exploration:		
Arctic Alaska	NA	$707
Interior Alaska	NA	119
Western Alaska	NA	1,243
Southwestern Alaska	NA	52
South-central Alaska	NA	849
Southeastern Alaska	NA	1,544
Total metals	NA	4,514
Oil and gas (statewide):		
Exploration	$74,600	63,600
Development drilling	37,200	66,400
Production	71,800	28,700
Refinery construction and maintenance	34,800	55,800
Pipeline construction	43,800	18,200
Total oil and gas	262,200	232,700
Grand total	NA	237,214

NA Not available.

Source: Division of Mines and Geology, Department of Natural Resources, Alaska.

Court of Appeals in San Francisco ruled that the Interstate Commerce Commission (ICC), not the Federal Maritime Commission, had authority. The ruling upheld Alaska Steamship Co. in filing certain tariffs with the ICC in 1967. In a later decision, the U.S. Court of Appeals made a similar ruling in another case. The Circuit Court ruled that joint rates fall under ICC regulations no matter how short the motor carrier haul involved. It ruled further that freight carried any distance aboard Alaska ferries, as part of the Alaska highway system, falls under the ICC. Involved along with Alaska Steamship Co. were Sea-Land Service of Alaska, Inc., and Puget Sound-Alaska Van Lines.

Setting aside its own suspension order, the ICC allowed a 9-percent joint-rate increase by Sea-Land of Alaska, Inc. The Commission noted that the increase was to be subject to a final hearing early in 1969. Sea-Land announced the new rates after the Federally owned Alaska Railroad (ARR) posted a similar increase. The ICC twice refused to suspend the ARR increase. Affected by the ARR rate was freight carried to Alaska by Puget Sound-Alaska Van Lines, Alaska Steamship Co., and Canadian National railcar service. Anchorage and Fairbanks merchants and civic groups protested the increases, but to no avail.

In southeastern Alaska, Alaska Steamship Co. announced plans to lower rates on most full vanloads of cargo to Juneau, Ketchikan, and other southeast points. Rates on less than full container lots were increased. Alaska Steam's southeastern service was entirely a container operation with vans moving by tug and barge rather than on steamships. With the inauguration of Alaska State ferry service between Seattle and southeastern ports, Alaska Steam, through a subsidiary, made limited use of the State ferries in serving the Panhandle.

Table 6.—Coastwise receipts and foreign mineral trade

(Short tons)

Commodity	1966			1967		
	Coastwise receipts	Imports	Exports	Coastwise receipts	Imports	Exports
Bituminous coal and lignite	123	--------	--------	79	--------	--------
Gasoline	361,567	4,839	--------	354,348	--------	--------
Kerosine, distillate, residual fuel oil	991,432	--------	--------	1,037,850	350,895	--------
Asphalt, tar, pitches	35,651	--------	--------	11,848	--------	--------
Lubricating oils and greases	3,798	--------	--------	564	--------	--------
Petroleum and coal products, n.e.c.	9,467	85,850	--------	7,001	89,059	--------
Building cement	24,724	29,614	--------	20,904	3,821	--------
Building stone, unworked; crushed and broken stone	200	--------	--------	410	--------	--------
Clay, ceramic and refractory materials	4,586	--------	--------	10,855	--------	--------
Structural clay products including refractories	1,438	10	--------	2,167	102	13
Sulfur	--------	8,830	--------	36	5,775	--------
Sand and gravel	1,680	825	--------	2,579	3,749	--------
Iron ore and concentrate	--------	--------	--------	--------	--------	--------
Iron and steel scrap	--------	--------	81	1,423	--------	--------
Iron and steel products	7,705	9,614	--------	8,138	4,242	--------
Aluminum and aluminum alloys, unworked	22			183	--------	--------
Lead and zinc including alloys, unworked	--------	--------	--------	--------	--------	--------
Nonferrous metal ores and concentrates, n.e.c.	20	--------	22,143	54	--------	16,189
Nonferrous metals primary smelter products, basic shapes, wire, castings and forgings, except copper, lead, zinc and aluminum	74	106	--------	61	--------	--------
Fertilizer materials	166	--------	--------	319	--------	--------

Source: U.S. Army Corps of Engineers, Waterborne Commerce of the United States, Part 4, Pacific Coast, Alaska, and Pacific Islands. Calendar years 1966–67.

Airfreighting, stimulated by the mounting activity associated with petroleum operations on the North Slope, made spectacular increases in all categories. From Fairbanks, eight Hercules cargo planes were carrying freight to North Slope drilling projects making an average of four round trips per day. The Hercules, developed by Lockheed for military cargo hauling, was first used in Alaska in 1965 by Alaska Airlines. The four-engine propjet, designed specifically for use on low-grade airstrips, was particularly adaptable to the primitive conditions existing at North Slope installations.

In June, Wien Consolidated Airlines began service on its main routes with Boeing's short-range 737 twin jet. Wien planned to use three 737's in the Alaska service. Special outfitting for gravel-runway operations would allow use of the 737 at such points as Dillingham, Kotzebue, and Prudhoe Bay. Wien was investigating the potentials of Boeing's 747 jumbojet to handle the expanding transport requirements stemming from the Arctic oil strikes. When permanent settlements are established and oil begins flowing to market, Wien officials envisioned economic use of the huge cargo freighter.

Early in the year Interior Airways, Inc., long active in charter flight service, began daily scheduled service between Anchorage and Fairbanks using the Fairchild F–27 propjet. Interior operated under temporary authority from the Alaska Transportation Commission. Both Northern Consolidated Airlines (later merged into Wien) and Alaska Airlines were flying nonstop on the Anchorage-Fairbanks run. In a parallel action, Interior purchased the equipment and the routes of Alaska Aeronautical Industries. Interior thus entered into competition with Alaska Airlines and Western Airlines on scheduled passenger service between Anchorage and Kenai Peninsula points. Flights to Kenai, Soldotna, Beluga River, Swanson River, and Fire Island were involved.

Continuing the trend toward consolidation of airlines operating in Alaska, mergers in process as the year began were completed. Following the merger of Cordova Airlines into Alaska Airlines in February, the new combination merged Alaska Coastal Airlines in April. The three-way merger gave Alaska Airlines routes from Ketchikan in the extreme southeast, to Kotzebue on the Chukchi Sea far to the northwest.

The merger of Wien Air Alaska and Northern Consolidated Airlines received approval of both groups of stockholders. Using modern commercial aircraft, the surviving company, Wien Consolidated Airlines, Inc., served most of the major points in Alaska as well as Whitehorse in the Yukon Territory. In addition, Wien Alaska served Eskimo villages and other points with small airfields using small bush-type planes.

AEC awarded a contract of $2.76 million to Alaska Airlines for passenger-freight service on a Seattle-Anchorage-Amchitka route. Amchitka was the scene of an AEC underground nuclear testing site. Alaska Airlines provided twice weekly passenger-cargo flights using Boeing 727 fanjets and once-a-week freight flights using the big Lockheed Hercules.

Table 7.—Freight rates, Seattle to selected Alaskan cities in 1968 Hydrotrain service[1]

(Cents per hundred pounds)

Commodity	Minimum shipment (pounds)	From Seattle to—		
		Anchorage via Whittier	Fairbanks via Whittier	Seward via Whittier
Groceries	60,000	288	302	----------
Do	80,000	189	258	----------
Do	[2] 100,000	118	178	----------
Iron or steel articles	50,000	283	349	278
Do	80,000	194	289	187
Do	100,000	183	228	177
Machinery	60,000	269	316	254
Do	80,000	231	278	216
Do	100,000	220	267	205
Lumber	80,000	186	289	187
Do	100,000	175	228	177
Do	120,000	178	----------	----------
Ores and concentrates (southbound only)[3]	60,000	119	158	----------
Do	80,000	100	140	----------
Do	100,000	95	184	----------
Petroleum and products	60,000	229	336	229
Do	80,000	191	298	191
Do	100,000	180	287	180

[1] Rates include all-risk insurance.

[2] Excess over 80,000-pound minimum when loaded in or on same car.

[3] Value not to exceed $60 per ton. Rate increases 25 percent for each additional $60 (or fraction) per ton valuation.

Source: The Alaska Hydro-Train.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Both tonnage and value of coal decreased substantially in 1968 as a result of the shutdown of major strip operations in the Matanuska Valley fields. With the conversion of the Anchorage military bases from coal to natural gas fueled power and heating plants, the Matanuska operators lost 95 percent of their markets. The Evan Jones operations, shut down in March, had been in continuous production since 1922. Alaska Matanuska Coal Co., operating the Premier mine, was the only active operator in the valley. Premier produced small quantities of coal for local use.

In the Nenana (Healy River) field Usibelli Coal Mine, Inc., and the Cripple Creek mine of Vitro Minerals Corp. continued to mine strip coal. In the fall Earth Resources Co. of Dallas acquired Vitro Minerals. The latter had been a subsidiary of Vitro Corporation of America. The two northern operations increased both tonnage and value of coal over the 1967 figures. Unit value increased nominally. Neither operator gave the Bureau of Mines permission to publish figures on the operations.

New contracts awarded by the Department of Defense for coal to supply the northern military bases in fiscal year 1969 were 225,334 tons at $1,426,364 to Vitro and 194,940 tons at $1,169,640 to Usibelli. In fiscal year 1968, Defense contracted for 272,000 tons from Usibelli and 250,000 from Vitro. Some of that coal, however, was shipped into the Anchorage area to help fuel the southern military bases.

In the Bering River coalfield north of Controller Bay, Cortella Coal Corp. of Cordova continued to examine the deposits in an effort to establish export markets for the coals in Japan. In 1967, Cortella had taken over interests of Jewell Ridge Coal Co. in the Bering River field. Coking characteristics of the coals, reported suitable for the Japanese markets, were the main attraction in the effort to justify exploration of this reportedly highly faulted and tilted coal field.

Nearly 4 tons of samples were shipped to Tokyo by Cortella for trial use by five of the leading Japanese coal importers. Exploration done over the summer months disclosed in excess of 8 million tons of recoverable coal reserves. Tentative plans called for initial production on a limited basis of 150,000 to 500,000 tons per year, with continued exploration planned to obtain additional geological information. An eventual output of 1 million tons per year was envisioned.

Petroleum and Natural Gas.—Two successful spectacular wildcat well completions on the North Slope brought Alaska worldwide prominence as an oil province with major production potential. At Prudhoe Bay on the Beaufort Sea, Atlantic Richfield Corp., associated with Humble Oil and Refining Co., brought in Prudhoe Bay No. 1 as a major oil discovery. At Sag River, some 7 miles southeast of the Prudhoe Bay find, the copartners brought in Sag River No. 1. On the basis of these two wells, competent industry analysts were estimating North Slope reserves at up to 10 billion barrels of petroleum. Such reserves were significant even on a world basis.

Table 8.—Production of crude petroleum and natural gas

Year	Crude petroleum: Thousand 42-gallon barrels	Crude petroleum: Value (thousands)	Natural gas[1]: Million cubic feet	Natural gas[1]: Value (thousands)
1964	11,059	$33,627	6,238	$1,719
1965	11,128	34,073	7,255	1,799
1966	14,358	44,007	11,267	2,794
1967	29,126	91,164	14,438	3,610
1968	66,204	186,695	17,343	4,388

[1] Comprises gas either sold or consumed by producers, including losses in transmission, quantities added to storage and increases of gas in pipelines.

Table 9.—Oil and gas lease acreage under Federal supervision

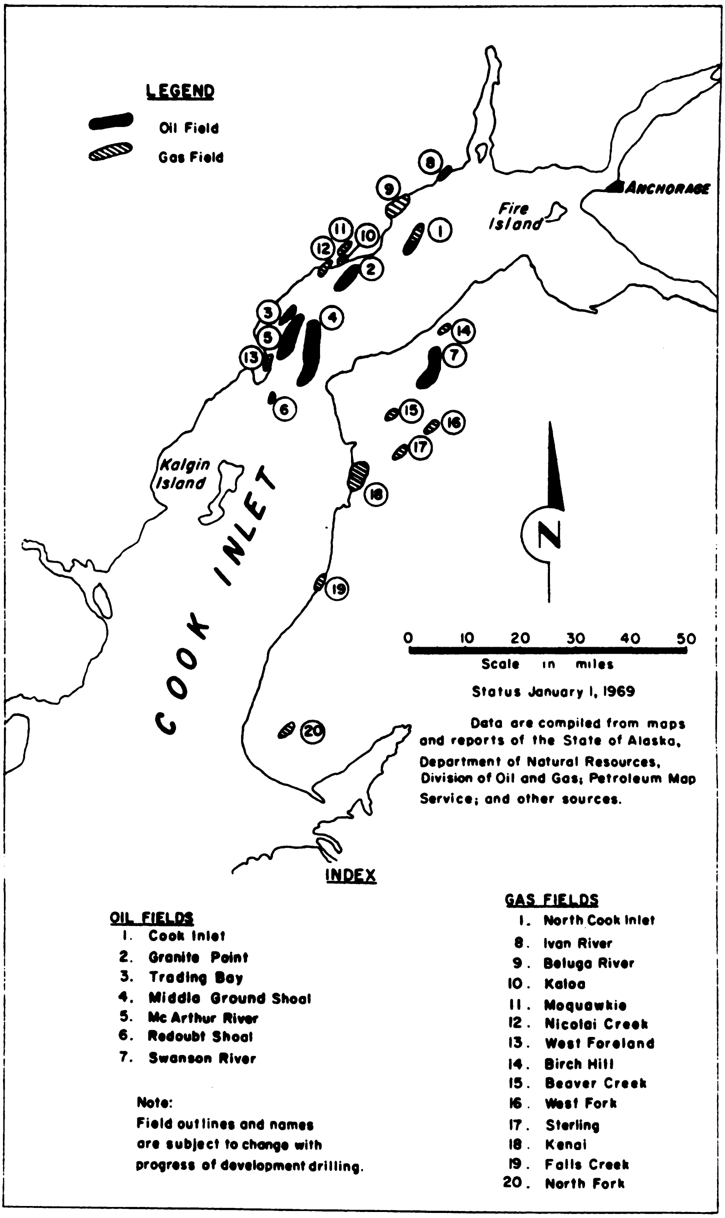
Year	Thousand acres
1964	11,600
1965	10,184
1966	9,275
1967	7,185
1968	6,841

Source: 1964–68 Geological Survey, U.S. Department of the Interior.

At yearend, the Slope was alive with activity. Besides the Atlantic-Humble operations, BP Exploration Co., Inc. (a subsidiary of British Petroleum, Ltd.); Colorado Oil and Gas Corp.; Mobil Oil Corp., and Phillips Petroleum Co., Pan American Petroleum Corp. (Standard Oil Co. of Indiana); and Standard Oil Co. of California were active. Three exploratory wells were being drilled and plans were announced for at least six additional wells to be drilled during the winter.

In other exploratory drilling, Pan American brought in the Redoubt Shoal Unit 2 (adjacent to West Foreland) as a new oil discovery and the Albert S. Kaloa, Jr., No. 1 on the Tyonek Reserve as a new gas discovery. These two, with the two North Slope exploration wells, were the only successful wildcats. Fourteen exploratory wells, at various sites in the Cook Inlet Basin, Alaska Peninsula, and the Matanuska Valley, were dry holes.

Crude oil production, at 66.2 million barrels, was more than double that of 1967 which in turn was more than twice the 1966 output. Both the increases were a result of rapid development of the offshore Cook Inlet fields; the onshore Swanson River field showed only a small increase over the 1967 production figures. Daily production reached a peak of 197,000 barrels per day in June, declined somewhat from the peak, and climbed back to 192,000 barrels daily



Status January 1, 1969

Data are compiled from maps and reports of the State of Alaska, Department of Natural Resources, Division of Oil and Gas; Petroleum Map Service; and other sources.

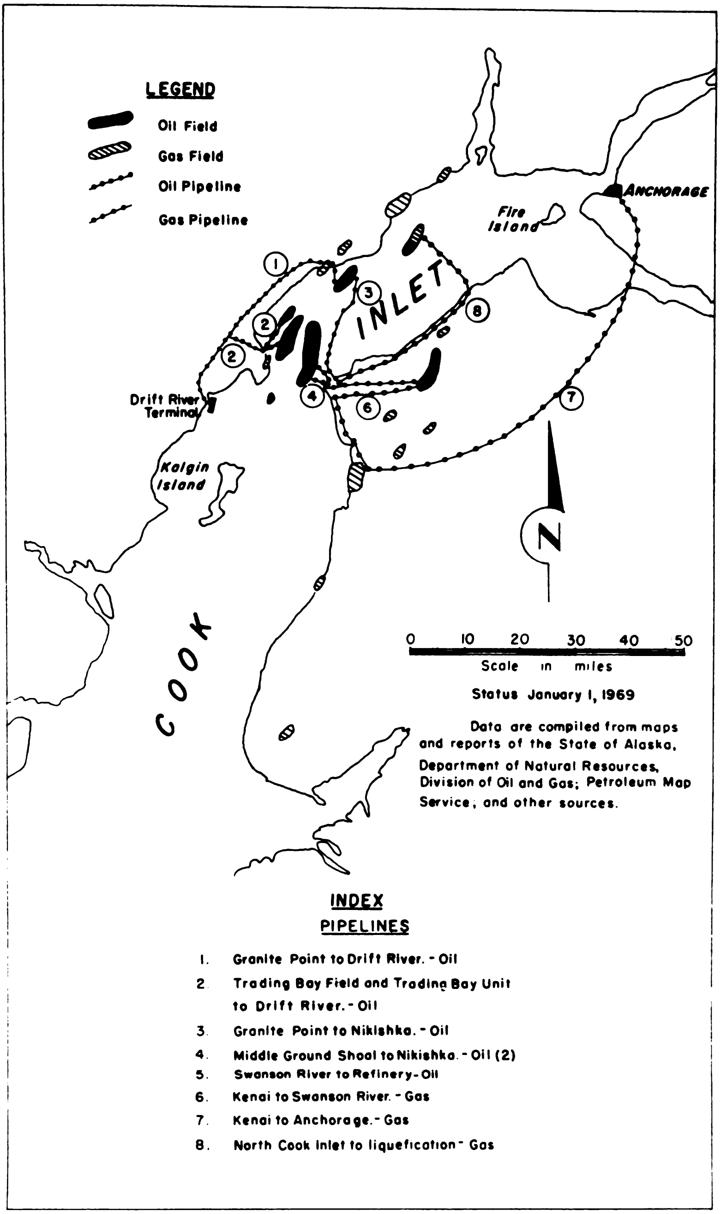
INDEX

OIL FIELDS
1. Cook Inlet
2. Granite Point
3. Trading Bay
4. Middle Ground Shoal
5. Mc Arthur River
6. Redoubt Shoal
7. Swanson River

Note:
Field outlines and names are subject to change with progress of development drilling.

GAS FIELDS
1. North Cook Inlet
8. Ivan River
9. Beluga River
10. Kaloa
11. Moquawkie
12. Nicolai Creek
13. West Foreland
14. Birch Hill
15. Beaver Creek
16. West Fork
17. Sterling
18. Kenai
19. Falls Creek
20. North Fork

Figure 2.—Cook Inlet oil and gasfields.


LEGEND
Oil Field
Gas Field
Oil Pipeline
Gas Pipeline
Fire Island
ANCHORAGE
INLET
Drift River Terminal
Kalgin Island
COOK
1
2
2
3
4
6
7
8
N
0 10 20 30 40 50
Scale in miles
Status January 1, 1969
Data are compiled from maps and reports of the State of Alaska, Department of Natural Resources, Division of Oil and Gas; Petroleum Map Service, and other sources.
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PIPELINES
1. Granite Point to Drift River. - Oil
2. Trading Bay Field and Trading Bay Unit to Drift River. - Oil
3. Granite Point to Nikishka. - Oil
4. Middle Ground Shoal to Nikishka. - Oil (2)
5. Swanson River to Refinery - Oil
6. Kenai to Swanson River. - Gas
7. Kenai to Anchorage. - Gas
8. North Cook Inlet to liquefication - Gas

Figure 3.—Cook Inlet oil and gas pipelines.

by yearend. The repressurization program at Swanson River was again expanded with marginal wells being converted to gas injection. Some form of secondary recovery or pressure maintenance programs was under consideration for the Cook Inlet offshore fields to combat reservoir pressure declines.

Two separate firms announced plans to construct oil refineries on the Kenai Peninsula. Alaska Oil and Refining Co. planned to build a 20,000-barrel-per-day plant with jet fuel as the major product. Western Frontier Oil and Refining Co. planned a 5,000-barrel-per-day topping plant to produce gasoline, kerosine distillate, jet fuel, and diesel fuel. No firm schedules for construction were released.

Total gas sales, excluding Kenai unit gas transferred to the Swanson River field for repressurization, amounted to 17,343 million cubic feet valued at $4.39 million. Two additional gasfields on the west side of Cook Inlet were put in production during the year. Beluga River field, a 1962 discovery by Standard Oil Co. of California, began supplying gas to Chugach Electric Association, an REA (Rural Electrification Administration) cooperative. Texaco Inc. sold gas from the Nicolai Creek field to onshore pipeline facilities and to offshore operators developing Cook Inlet fields.

Construction on Collier Carbon and Chemical Corp.'s prilled urea and ammonia plant continued; by yearend initial tests were being made on some of the plant's completed systems. Collier is a subsidiary of Union Oil Co. of California, holder with Marathon Oil Co. of the Kenai unit gasfield. Stringent controls were issued by the State of Alaska to control effluent disposal into Cook Inlet.

Phillips Petroleum Corp. was on schedule with the construction of its liquefied natural gas plant. Liquefaction was expected to begin early in 1969. Output was to be shipped to Japan. Marathon, in a joint venture with Phillips, was to furnish 30 percent of the feedstock from its share of Kenai unit gas. Phillips and associates were to supply the remaining 70 percent from the offshore North Cook Inlet field. Phillips prepared pipelines and multiwell platform facilities; by yearend the company had three development wells drilling.

A Tokyo firm expressed interest in contracting for 430 million cubic feet of natural gas per day from Alaska sources. The amount, some three times the expected output of the $57 million Phillips-Marathon liquefaction project, was seen as beyond the uncommitted reserves available. Industry and State experts looked to development of some of the one-well, shut-in fields as sources for the new demand. Japanese officials cited the increased industrial and domestic dependence on natural gas in Japan as evidence of a continuing need for imports. The total lack of smog producing sulfur in the Alaska gas was a strong plus in seeking to establish an Alaska source of supply.

In an effort to conserve natural gas which is produced with oil, a combine of Alaska operators announced plans to build a $3 million vapor recovery plant on the west side of Cook Inlet in 1969. The plant was to process casinghead gas now being flared from offshore platforms; the recovered liquids were to be recombined with the crude oil production. Alaska lawmakers had passed legislation in 1968 authorizing the Commissioner of Natural Resources to exact penalties against operators upon a determination that produced natural gas was being wasted. The law called for penalties equal to the fair market value at the point of waste for gas flared, vented, or otherwise released.

In oil and gas drilling, total development footage was 1,002,339; exploration footage totaled 172,444 for a total of 1,174,783 feet drilled. The figures for 1967 were 614,427 development, 289,941 exploration, and 904,368 total. Of 108 development wells put down, 74 resulted in oil wells, six in gas wells, and six were dry holes. Seven completed wells were awaiting gas-lift equipment to assist flow, six wells (four of which were proposed for water injection) were suspended, three were testing, and six were drilling. Of 18 wildcat completions, three were oil wells, one a gas well, and 14 were dry holes. Six wildcats were drilling at yearend. Sixteen of the wildcats were upland wells, eight were offshore tests. The data were compiled from information furnished by the State Division of Oil and Gas.

METALS

Antimony.—No shipments of antimony ore or concentrate were made in 1968. Earl R. Pilgrim, operating the Stampede mine north of Mount McKinley in the Kantishna district, Yukon River region, reported production of 8 tons of concentrate running 41 percent antimony. Assessment work was done at the Klemm mine of Tillicum Mining Co. in the Petersburg district, southeastern Alaska region. Claim holders in other parts of Alaska did not respond to Bureau of Mines canvass forms.

Copper.—Major mining organizations continued to show interest in the copper potential of Alaska. In southeastern Alaska, where increased exploration activity resulted in the staking of 1,540 new claims, interest centered on low-grade copper occurrences. Deposits in the Klawock area drew renewed interest as did those on Gravina Island, near Kasaan in the McLean Arm, and at other points on Prince of Wales Island. Companies active included Humble Oil and Refining Co., Newmont Mining Corp., Utah Construction & Mining Co., United Copper Corp., Ltd., and El Paso Natural Gas.

In interior Alaska, examination of copper showings and exploration work on some deposits attested to the interest of major U.S. mining organizations in Alaska copper. At Pass Creek, east of Denali in the Cook Inlet-Susitna region, further investigations were made by a group headed by Tennessee Corp. At Orange Hill, southeast of Nabesna in the Yukon River region, Duval Corp. of Vancouver, with others, diamond drilled the huge low-grade copper-molybdenum deposit. The Orange Hill deposit was reliably reported to contain more than 200 million tons of quartz diorite running 0.40 percent copper and 0.02 percent molybdenum. Other major companies active in this part of Alaska included American Metal Climax, American Exploration, Phelps Dodge, Hanna Mining, Bunker Hill, and American Smelting and Refining Co.

St. Eugene Mining Co. (Falconbridge Nickel) continued examination of the large low-grade copper showings in the Kasna Creek area near the south shore of Lake Kontrashibuna in the Lake Clark region. The company was active in other sections of the State. Bear Creek Mining Co. (Kennecott Copper Corp.) made extensive reconnaisance surveys in the Alaska Range.

In northwestern Alaska, Kenncott's New Mines Division turned the Bornite operation back to the Bear Creek exploration subsidiary for further evaluation. Bear Creek, in addition to exploration on the Bornite deposits, made reconnaisance surveys of various places in the Kobuk area and drilled at least one showing. Kennecott had invested more than $10 million since 1956 in an attempt to establish the Bornite deposit as economic. A major water control problem encountered in 1967 in the main, 1,100-foot vertical shaft was a serious setback in their attempt to open this north of the Arctic Circle copper deposit.

Previously unknown copper-silver-zinc deposits in a remote area of the Alaska Range near Farewell were described in a release by the U.S. Geological Survey. Outcrops of massive, fine-grained sulfide bodies were found during 1967 field studies made in connection with the heavy metals program. The USGS release triggered intense prospecting in the area and considerable claim staking. Home Oil Co. of Canada, Granby Mining, and Falconbridge were reported to have crews in the area.

Gold.—Physical volume of output, following the trend first showing in 1950, decreased 7 percent from the 1967 figures. Value of output, under the influence of the two-tier price system adopted in March, increased by 4 percent. Average value per ounce for 1968 was $39.26. Gold had been unchanged at $35 since the revaluation completed in February 1934.

Of 21,262 ounces produced, 21,124 ounces or more than 99 percent was derived from placer operations. Alaska had had no significant lode gold production since World War II conditions forced the closing down of gold mining.

U.S. Smelting, Refining and Mining Co. operated a medium-sized dredge at Hogatza in the Hughes district, Yukon River region. Small operations were active on Prince and Flat Creeks in the Iditarod district, on Ganes Creek in the Innoko district, on Long Creek in the Ruby district, on Marvel Creek in the Aniak district, and on Taylor Creek in the Kougarok district, Seward Peninsula. Other smaller operations were scattered about in various placer camps.

Cubic yards washed fell to 1.2 million, a decline of 36 percent from the 1967 figure. In the post-World War II peak year of 1950, Alaska placer miners washed 17.6 million cubic yards. Even the 1950 figures were well down from the prewar

Table 10.—Mine production of gold, silver, and other metals,[1] in terms of recoverable metals[2]

Year	Mines producing		Material sold or treated[3] (short tons)	Gold (lode and placer)		Silver (lode and placer)		Other		Total value (thousands)
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces	Value (thousands)	Short tons	Value (thousands)	
1964	4	87	2,493	58,416	$2,045	7,336	$9	11	$7	$2,061
1965	6	69	3,305	42,249	1,479	7,673	10	41	26	1,515
1966	4	55	7,346	27,325	956	7,193	9	W	W	965
1967	W	50	W	22,948	803	5,787	9	W	W	812
1968	W	37	W	21,262	835	3,900	8	W	W	843

W Withheld to avoid disclosing individual company confidential data.

[1] Includes copper, lead, and zinc produced.

[2] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore shipped to smelters during calendar year indicated.

[3] Does not include gravel washed.

Table 11.—Placer production of gold

Year	Mines producing[1]	Material treated (thousand cubic yards)	Gold recovered		
			Troy ounces	Value (thousands)	Average value per cubic yard
1964	87	3,313	56,284	$1,970	$0.595
1965	69	1,785	38,686	1,354	.758
1966	55	[r] 1,828	26,532	929	[r] .508
1967	50	1,888	22,948	803	.425
1968	37	1,101	21,124	829	.753

[r] Revised.

[1] Excludes itinerant prospectors, "snipers," "highgraders," and others who gave no evidence of legal right to property.

peak of 1940 when 23.3 million cubic yards was washed by dredges and an unrecorded but substantial quantity by other placer methods. Thus did war and its attendant economic disruptions toll the death knell for the once flourishing Alaska gold industry. Nor did the new two-tier pricing system seem to offer much promise, at least over the short term, for a revival of the industry. At yearend the free market price had risen to $42.05 or roughly 20 percent above the old $35 price. This was not nearly enough to offset the effects of increases in other parts of the economy.

Despite the troubles of the industry, activity and interest in offshore placer deposits continued strong through 1968. Interest centered in Norton Sound, particularly in the Nome area. Here Shell Oil Co. and American Smelting Refining and Mining Co., in a joint venture, were drilling through the ice at yearend. Some 28 men were working on a 12-hour two-shift basis coring the gold bearing sands of the offshore deposits. Work was planned as far as 3 miles seaward. Shell had filed on offshore acreage in 1962 and has since been probing the submerged deposits, or otherwise testing.

Also at Nome, Rowen Drilling Co. was reported drilling American Exploration Company holdings. Ocean Science and Engineering was said to have interests in the area. Amerada Petroleum Corp. and Occidental Petroleum both held permits for prospecting. In the Gastineau Channel area near Juneau in southeastern Alaska, Global Marine, Inc., did some seismic work and bottom sampling.

Chandalar Gold Mining and Milling Co., lease holder on high-grade lode gold deposits in the Chandalar district, proceeded with prepartions to mine the rich, north of the Arctic Circle, deposits. In late winter some 730,000 pounds of equipment and supplies was flown into the district and moved by tractor sled to the mine site on Tobin Creek. Living quarters, office, laboratory, shop, and other buildings were erected. Other work included road improvement and maintenance, trenching, airstrip construction, millsite preparation, stripping, and clearing ice from underground workings.

Iron Ore.—There was no production of iron ore in 1968 and no important developments were reported. In southeastern Alaska, Utah Construction & Mining Co. resumed exploration work. The company held iron-copper deposits at Mount Andrew and Poorman on the Kasaan Peninsula, Prince of Wales Island.

United States Steel Corp. reported assessment work only at its Klukwan and other holdings in southeastern Alaska. Late in the fall, a Japanese economic journal, Nihon Keizai Shumbun, reported that U.S. Steel had approached Japanese steelmakers and trading firms on the possible joint development of the Klukwan deposits. These were huge low-grade magnetic deposits, both lode and placer, under exploration and development since the late 1940's. The Japanese had shown interest in Klukwan's iron resources some 10 years previously, but the 2 to 3 percent of titania contained was unacceptable. Changes in steelmaking techniques since that time indicated that, with blending, Klukwan ores might be suitable for Japanese steelmakers.

Mercury.—Production of mercury remained at the depressed levels of recent years in spite of an average calculated price of $535.56 per 76-pound flask for 1968. Alaska had had no significant output of mercury since Alaska Mines & Minerals, Inc., shut down company operations at the Red Devil mine below Sleetmute on the Kuskokwim River.

The small recorded production from the State came from the White Mountain deposit operated by Lyman Mining Co. and from the Alice and Bessie Mine (formerly called the Parks property) operated by George H. Willis.

Prospecting and exploration activity maintained the brisk pace of 1967. At the Schaefer deposits on Beaver and Cinnabar Creeks, Aniak district, Georgetown subdistrict, Diamond Shamrock Chemical Co., a division of Diamond Shamrock Corp., expended considerable effort in drilling and otherwise testing the high-grade cinnabar showings on the Lucky Day and Broken Shovel groups of claims. The deposits, 300 miles west of Anchorage were in a particularly inaccessible part of the Kuskokwim region.

Alaska Mines & Minerals reentered the Red Devil Mine in an attempt to outline sufficient ore to justify reopening of the mine. The Red Devil, shut down in August 1963 with the price of mercury below $200 per flask, had been the major Alaska mercury producer. Output from this property had enabled Alaska to rank third among the mercury-producing States for a number of years prior to the 1963 shutdown.

In the Dillingham area, some drilling and other work was done on the Red Top mine at Marsh Mountain, Tikchik subdistrict, Bristol Bay region. High-grade stringers of nearly pure cinnabar in a zone of graywacke had been mined from the Red Top in earlier work. Underground work, comprising of about 550 feet of drifts and crosscuts, showed the surface mineralization extending downward in some areas. Other exploration or examination work, including some by the Bureau of Mines, was done at the Egnaty Creek, Willis, Barometer, and Kolmakof deposits, all in the Kuskokwim River region.

Nickel.—Except for assessment work necessary to hold unpatented mining claims, there was no significant step-up in interest in Alaska nickel deposits.

At the Brady Glacier deposit in Glacier Bay National Monument, Newmont Exploration, Ltd., accomplished further drilling and geological studies on its patented claims. Newmont had been exploring the deposits beneath the Brady Glacier for a number of years and in 1965 acquired patents to claims on the deposits.

Platinum-Group Metals.—Goodnews Bay Mining Co. continued dredging operations on the Salmon River in the extreme southwestern part of the Kuskokwim River region. Goodnews Bay was the only primary producer of the metal in the Nation. The company, a placer producer for 35 years, did not release operating figures for publication. Physical volume and value of output were somewhat greater than the figures for 1967.

The lode source of these productive Goodnews placers was again under investigation. Past efforts to uncover a mineable lode source had been unsuccessful or inconclusive. At least two major companies were reported as searching for a lode source in the Goodnews area.

Scrap.—Minor quantities of ferrous and nonferrous scrap were shipped to Seattle. Value of nonferrous scrap was greater than that of 1967 while tonnage was appreciably less. Ferrous scrap decreased in both tonnage and value. Alaska scrap figures had no significance in national totals.

Silver.—Silver production, following the trend in placer gold output, was minor; much of Alaska's silver is a byproduct of gold placering. Lode mines in the Fairbanks district reported small quantities of silver output.

Uranium.—No uranium ore was produced in 1968. Kendrick Bay Mining Co., a subsidiary of Standard Metals Corp. announced an agreement with Newmont Mining Corp. for further development of the Kendrick Bay holdings at Bokan Mountain, Prince of Wales Island. Newmont Exploration, Ltd. was named as the operating company. The Bokan Mountain (Ross-Adams) deposit was shut down in 1964 because of loss of market. Appreciable reserves were said to remain at the time of the closing. Bokan Mountain was the only commercial uranium deposit developed in Alaska.

The State Division of Mines and Geology began a new program of uranium prospecting in Alaska. Noting that the U.S. Geological Survey uranium investigations in the 1940's and 1950's were confined almost entirely to hydrothermal vein-type deposits while at least 80 percent of known world reserves are in sedimentary beds, the Division undertook a study of potential sedimentary uranium structures. Previous Geological Survey work had indicated several areas worthy of additional study, particularly the Lost River and Brooks Mountain areas on the Seward Peninsula and the southeastern Alaska region.

NONMETALS

Barite.—Alaska Barite Co. continued to mine from the Red Cliff holdings on Castle Island, 25 miles west of Petersburg. The company stationed a barge-mounted processing plant off the mouth of the Kenai River in Cook Inlet. Crude ore from the Red Cliff deposits was barged to Cook Inlet for processing into a product for use in drilling mud in Alaska's booming oil well drilling industry. Formerly, the barite had been shipped to Gulf Coast ports for processing.

Gem Stones.—Jade was produced from Dahl Creek and adjacent areas in the Shungnak district, northwestern Alaska region. One operator sold raw jade at Kotzebue in multiton boulder size. A 30-ton boulder was reported as exchanged for a bulldozer. In a cash sale, two boulders, one weighing 7½ tons brought $30,000. Other smaller boulders were sold.

Sand and Gravel.—Physical volume and value of sand and gravel both decreased appreciably from the figures for 1967. Physical volume decreased by 20 percent while value dropped by 22 percent. The decreases reflected lessened construction activity. Unit value was $1.13 compared with $1.17 in 1967.

Seventeen commercial producers accounted for 9 percent of output and 8 percent of value. Average value of commercial production was $1.10 compared with $0.96 in 1967. Commercial operators washed 285,000 tons (18 percent) of output valued at $812,000 or $2.85 per ton. Unwashed product was 1,279,000 tons valued at $0.71 per ton. Commercial producers included the Alaska Railroad, an agency of the U.S. Department of Transportation. The railroad was classed as a commercial producer to permit comparison with data published for other States.

Thirty-one Federal, State, and municipal agencies (or their contractors) produced sand and gravel. For government agencies, output was 16,449,000 tons valued at $18,643,000 or $1.13 per ton. The Alaska Department of Highways, the U.S. Army Corps of Engineers, and the State Division of Aviation were the major producers. The Alaska Department of Highways furnished

Table 12.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Construction:				
Building:				
Sand	49	$223	154	$316
Gravel	54	234	625	679
Paving:				
Sand	506	1,700	644	822
Gravel	1,399	4,154	1,220	1,562
Fill:				
Sand	4,852	5,206	840	475
Gravel	15,499	14,700	14,519	16,490
Railroad ballast: Gravel	6	14	7	5
Other:				
Sand	3	11	3	14
Gravel	2	6	1	3
Total	22,370	26,248	18,013	20,366
Commercial:				
Sand	96	278	113	354
Gravel	1,726	1,471	1,451	1,369
Government-and-contractor: [1]				
Sand	5,314	6,862	1,528	1,278
Gravel	15,234	17,637	14,921	17,370

[1] Approximate figures for operations by the State, counties, municipalities, and other Government agencies under lease.

72 percent of the tonnage and 87 percent of the value credited to government agencies.

Of total production, 85 percent was used as fill and 10 percent for paving. Building construction and other uses accounted for the remainder. Washed or otherwise prepared product was 2,653,000 tons with a unit value of $1.28. Untreated product was 15,360,000 tons at $1.10 per ton. There was no recorded production of industrial sand.

Stone.—Production and value of stone, reflecting the lessened activity in construction, were both down from the 1967 figures. Physical volume decreased 13 percent while value of product was 8 percent less. Unit value increased from $2.34 per ton to $2.48.

Among stone producers, the U.S. Army Corps of Engineers was the leader in both tonnage and value. Other major producers included Central Construction Co., Inc., Bureau of Public Roads, the Alaska Department of Highways, and the Bureau of Indian Affairs.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	Region
Barite: Alaska Barite Co	Tacoma, Wash	Open pit	Southeastern Alaska.
Coal:			
Usibelli Coal Mine, Inc	Usibelli, Alaska	Strip mine	Yukon River.
Vitro Minerals Corp	Fairbanks, Alaska	do	Do.
Alaska Matanuska Coal Co	Palmer, Alaska	do	Cook Inlet-Susitna.
Gold:			
U.S. Smelting, Refining and Mining Co.	New York, N.Y	Dredge	Yukon River.
Prince Creek Mining Co	Flat, Alaska	Nonfloat	Do.
Ruby Mining Co	Ruby, Alaska	do	Do.
Natural gas:			
Mobil Oil Corp	Anchorage, Alaska	Gas fields	Cook Inlet-Susitna.
Standard Oil Co of California	do	do	Do.
Texaco Inc	do	do	Do.
Union Oil Co. of California	do	do	Kenai Peninsula.
Petroleum—crude:			
Pan American Petroleum Corp	do	Oil fields	Cook Inlet-Susitna.
Shell Oil Co	do	do	Do.
Standard Oil Co. of California	do	do	Kenai Peninsula.
Texaco Inc	do	do	Cook Inlet-Susitna.
Union Oil Co. of California	do	do	Do.
Platinum-group metals: Goodnews Bay Mining Co.	Fairbanks, Alaska	Dredge	Kuskokwim River.
Sand and gravel:			
Alaska Department of Highways	Juneau, Alaska	Open pit	Various.
U.S. Army Corps of Engineers	Anchorage, Alaska	do	Do.
State Division of Aviation	do	do	Do.
Stone:			
U.S. Army Corps of Engineers	do	Open quarrying	Do.
Central Construction Co., Inc	Seattle, Wash	do	Southeastern Alaska.
Bureau of Public Roads	Juneau, Alaska	do	Do.
Petroleum refining: Standard Oil Co. of California.	Nikiski, Alaska	Refinery	Kenai Peninsula.

The Mineral Industry of Arizona

This chapter was prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Arizona Bureau of Mines for collecting information on all minerals except fuels.

By Leonard P. Larson[1] and William C. Henkes[2]

Arizona's copper industry resumed full production during the second quarter of 1968. Thus, the value of mineral production in Arizona during 1968 was $617.5 million, an increase of $152.3 million over that of 1967. The State led the Nation in copper and pumice production and was second in output of molybdenum and perlite.

Table 1.—Mineral production in Arizona[1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Clays ... thousand short tons	[2] 67	[2] $37	77	$347
Coal (bituminous) ... do	1	5	---	---
Copper (recoverable content of ores, etc.) ... short tons	501,741	383,591	627,961	525,566
Fluorspar ... do	10,000	280	---	---
Gem stones	NA	150	NA	149
Gold (recoverable content of ores, etc.) ... troy ounces	80,844	2,830	95,999	[3] 3,769
Helium, grade A [4] ... thousand cubic feet	73,800	2,066	64,800	1,600
Iron ore (usable) ... thousand long tons, gross weight	W	W	16	124
Lead (recoverable content of ores, etc.) ... short tons	4,771	1,336	1,704	450
Lime ... thousand short tons	186	3,142	260	4,561
Mercury ... 76-pound flasks	W	W	192	103
Molybdenum (content of concentrate) ... thousand pounds	9,261	15,385	12,127	19,207
Natural gas (marketed) ... million cubic feet	1,255	193	881	142
Petroleum (crude) ... thousand 42-gallon barrels	2,924	8,188	3,370	9,606
Pumice ... thousand short tons	1,064	904	1,033	974
Sand and gravel ... do	[r] 18,463	[r] 18,409	13,981	14,423
Silver (recoverable content of ores, etc.) thousand troy ounces	4,588	7,112	4,958	10,633
Stone ... thousand short tons	1,910	3,491	3,293	6,239
Tungsten concentrate (60-percent WO_3 basis) ... short tons	W	W	1	3
Uranium (recoverable content U_3O_8) ... thousand pounds	83	[5] 666	295	[6] 1,923
Zinc (recoverable content of ores, etc.) ... short tons	14,330	3,967	5,441	1,469
Value of items that cannot be disclosed: Asbestos, cement, clay (bentonite 1967), diatomite, feldspar, gypsum, mica (scrap), perlite, pyrites, vanadium, vermiculite, and values indicated by symbol W	XX	13,503	XX	16,253
Total	XX	[r] 465,255	XX	617,541
Total 1957–59 constant dollars	XX	[r] 369,895	XX	[p] 464,544

[p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes bentonite; included with "Value of items that cannot be disclosed."

[3] Based on average U.S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968 and the New York selling price for the remainder of the year.

[4] Bureau of Mines estimate from non-company sources.

[5] Estimated based on $8.00 per pound f.o.b. mill.

[6] Estimated based on $8.00 per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 per pound for commercial sales.

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[1] Mining engineer, Bureau of Mines, Denver, Colo.

[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 2.—Value of mineral production in Arizona, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Apache	$11,895	$12,190	Petroleum, helium, sand and gravel, clays, natural gas, pumice, uranium, vanadium, stone.
Cochise	[r] 30,675	W	Copper, lime, silver, stone, gold, sand and gravel, zinc, lead.
Coconino	3,541	6,055	Uranium, stone, sand and gravel, pumice, copper, silver, lead, zinc.
Gila	43,680	61,248	Copper, lime, asbestos, molybdenum, silver, stone, gold, sand and gravel, mercury, clays.
Graham	311	157	Sand and gravel, copper, pumice, stone.
Greenlee	64,893	92,925	Copper, lime, silver, stone, gold, sand and gravel, molybdenum.
Maricopa	[r] 6,229	7,184	Sand and gravel, lime, mercury, mica, stone, clays, copper, gold, silver, vermiculite.
Mohave	26,682	31,535	Copper, molybdenum, silver, sand and gravel, stone, feldspar, zinc, gold, clays, lead.
Navajo	802	W	Sand and gravel, iron ore, stone.
Pima	[r] 151,151	198,077	Copper, cement, molybdenum, silver, sand and gravel, gold, stone, zinc, clays, lead, tungsten.
Pinal	[r] 91,310	129,325	Copper, molybdenum, silver, gold, sand and gravel, perlite, gypsum, stone, lime, pyrites, diatomite, iron ore, lead.
Santa Cruz	[r] 581	W	Sand and gravel, silver, stone, lead, tungsten concentrate, copper.
Yavapai	30,488	30,312	Copper, cement, zinc, molybdenum, stone, silver, lime, lead, sand and gravel, gold, gypsum, clays, iron ore, pumice.
Yuma	[r] 2,869	W	Copper, sand and gravel, stone, silver, lead, tungsten concentrate, zinc.
Undistributed [1]	150	48,580	
Total [2]	[r] 465,255	617,541	

[r] Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W in 1968.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Arizona business activity

	1967 [r]	1968 [p]	Change (percent)
Employment and labor force, annual average:			
Total nonagricultural employment, thousands	444.6	466.9	+5.0
Manufacturing, do	78.7	84.0	+6.7
Mining, do	13.4	15.3	+14.2
Contract construction, do	23.6	25.6	+8.5
Trade, do	102.0	105.9	+3.8
Government, do	104.2	108.8	+4.4
Services and miscellaneous, do	73.5	76.6	+4.2
All other, do	49.3	50.6	+2.6
Payroll data:			
Copper mining, millions	$85.0	$112.1	+31.9
Contract construction, do	$210.2	$235.4	+12.0
Manufacturing, do	$478.6	$534.6	+11.7
Retail trade, do	$263.6	$287.1	+8.9
Construction activity:			
Cement shipments to and within the State, thousand 376-pound barrels	3,579	4,440	+24.0
Total contract awards, millions	$448.1	$495.4	+10.6
Residential, do	$182.9	$213.6	+16.8
Nonresidential, do	$136.8	$163.8	+19.7
Nonbuilding, do	$128.4	$118.0	−8.1
Highway construction contracts awarded, do	$70.0	$46.0	−34.3
Business receipts:			
Mining, do	$391.7	$554.2	+41.5
Contract construction, do	$429.8	$455.6	+6.0
Retail sales (daily average), thousands	$722.2	$786.5	+8.9
Agricultural output, millions	$527.5	$555.2	+5.3
Mineral production, do	$465.3	$617.5	+32.7
Export trade [1], do	$23.4	$46.7	+99.6
Import trade, do	$110.0	$115.2	+4.7

[p] Preliminary. [r] Revised.

[1] Data not available for March, May, September, November, and December 1967; January and February 1968.

Sources: Division of Economic and Business Research, College of Business and Public Administration, The University of Arizona, Tucson, Ariz. 85725; Unemployment Compensation Division, Employment Security Commission of Arizona, Phoenix, Ariz. 85005; Engineering News-Record, v. 182, No. 14, Apr. 3, 1969, pp. 52–53; U.S. Bureau of Mines.

Compared with 1967 values, 13 commodities declined and 16 increased in value. There was no production of fluorspar. Substantial declines were recorded for lead ($886,000), sand and gravel ($4.0 million), and zinc ($2.5 million); whereas significant increases were reported for cement ($3.3 million), copper ($142.0 million), gold ($939,000), lime ($1.4 million), molybdenum ($3.8 million), petroleum ($1.4 million), silver ($3.5 million), stone ($2.7 million), and uranium ($1.3 million). Copper contributed 85 percent of the total value of mineral production in the State. Metals production comprised 91 percent of the total value of mineral output, nonmetals 7 percent, and fuels 2 percent.

Employment and Injuries.—Final statistics for 1967 on employment and injuries in the mineral industries, excluding the petroleum and natural gas industries, and preliminary data for 1968 compiled by the Bureau of Mines, are given in table 4.

Legislation and Government Programs.—The Office of Minerals Exploration (OME), U.S. Geological Survey, contracted to assist Amedee A. Peugnet in exploring for silver at the Eldorado group of claims in Yavapai County. Of the total cost of the work, estimated at $23,800, OME participation was 75 percent ($17,850).

Highway construction contracts awarded during 1968 totaled $46 million, $24 million or 34 percent less than in 1967. The awards included $24 million for road construction in the National System of Interstate and Defense Highways, $19 million for Federal-aid primary and secondary (ABC) highway systems and their urban extensions, and $3 million for State financed roads.[3] Of a total of 1,172.2 miles designated for the State as a part of the National System of Interstate and Defense Highways, 53 miles were opened to traffic during 1968, bringing the total mileage completed to 785.8.[4] An increase in the amount of crushed and broken stone used for road construction was more than offset by the decrease in sand and gravel and scoria used, due to the reduction in road construction contracts awarded.

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[3] Engineering News-Record, State Highway Departments' Construction Contracting Plans for 1969 and Budgets for Maintenance. V. 182, No. 14, Apr. 3, 1969, pp. 52–53.

[4] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1968. Press Release FHWA–295, Feb. 24, 1969.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	3	140	(1)	3	-------	-------	-------	-------
Metal	11,321	231	2,616	20,921	7	492	23.85	3,414
Nonmetal	293	222	65	547	-------	10	18.30	364
Sand and gravel	1,158	226	262	2,121	-------	44	20.74	2,413
Stone	412	263	108	873	-------	13	14.90	587
Total	13,187	231	3,051	24,465	7	559	23.13	3,158
1968:[p]								
Coal	5	139	(1)	3	-------	-------	-------	-------
Metal	10,810	278	3,053	24,534	12	502	20.95	3,875
Nonmetal	220	216	47	404	-------	6	14.87	468
Sand and gravel	1,020	237	242	1,936	2	42	22.72	6,970
Stone	405	266	108	867	-------	10	11.53	293
Total [2]	12,455	273	3,450	27,744	14	560	20.69	3,929

[p] Preliminary.
[1] Less than ½ unit.
[2] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES[5]

METALS

Copper.—Mines in Arizona yielded slightly more than 52 percent of the domestic primary copper production in 1968. Settlement of the strike at Arizona copper mines, that began in July 1967 and ended in March 1968, helped spur Arizona's mineral economy to near the record high of 1966. The strike, at its peak involving approximately 10,000 employees at approximately 10 locations, was one of the longest in the history of labor-management relations. The tie-up resulted in a loss to Arizona of an estimated 141,700 short tons of copper valued at $118.6 million in 1968.[6]

Production of copper from mines in the State totaled 627,961 short tons valued at $525.6 million. With the completion of the strike, most mines were worked at or near capacity. Output from the 13 large open pits and three principal underground properties accounted for 97 percent (608,302 tons) of the total output of primary copper; 80 percent was derived from open-pit ores and 17 percent from underground ores. Three percent was produced from 70 smaller operations. In 1967 these 13 open-pit and three underground mines also accounted for 97 percent of the State total output; the remaining 3 percent was supplied by 56 small operators.

Copper, mined throughout a large area of Arizona, was a significant factor in the economy of 12 of the 14 counties in the State. Pima County continued to lead all other counties in output; Pinal County was ranked second, followed by Greenlee, Gila, Cochise, Mohave, and Yavapai Counties.

Nine of the State's largest copper mines are controlled by four of the copper industry's largest producers: Phelps Dodge Corp., Magma Copper Co., American Smelting and Refining Co. (Asarco), and Kennecott Copper Corp. These four companies furnished 67 percent of the State's primary copper output.

Four mines owned by Phelps Dodge Corp. accounted for about 34 percent of the State production. From its two underground properties, Magma Copper Co. accounted for 14 percent of the total output. Asarco, with two open pits that accounted for about 10 percent, was third. Ray Mines Division, Kennecott Copper Corp., accounted for 9 percent of the total.

Porphyry copper mined at open pits in Cochise, Gila, Greenlee, Mohave, Pima, Pinal, and Yavapai Counties ranged from a low of 0.392 to 0.674 percent copper, averaging about 0.547 percent. In 1967 copper recovered from open-pit mines ranged from a low of 0.407 to 0.688 percent, averaging about 0.588 percent recoverable copper. In 1968 ore from the underground mines contained from 0.701 to 4.630 percent copper; the lower analysis represents the copper content of the ore block caved at San Manuel; the higher analysis, the ore produced at the Magma mine.

Companies operating the 13 largest open-pit mines moved about 83 million tons of ore to recover 453,000 tons of copper. The mining of 83 million tons of open-pit ore, the extension of existing pits, and the development of new ore bodies required the removal of 127 million tons of waste;

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[5] Portions of the material in this section were obtained from engineering and trade journals, company annual reports, and other related sources.

[6] Gerwin, B. H., Assistant to the Director, Department of Mineral Resources, State of Arizona.

Table 5.—Total value of mineral production in Arizona and production and value of copper in Arizona and the United States

Year	Arizona			United States		Arizona	
	Total value mineral production (thousands)	Copper production		Copper production		Percent of U.S. copper production	Percent of world copper production
		Short tons	Value (thousands)	Short tons	Value (thousands)		
1964	$536,821	690,988	$450,524	1,246,780	$812,901	55.4	13.0
1965	583,118	703,377	497,991	1,351,734	957,028	52.0	12.7
1966	622,079	739,569	535,004	1,429,152	1,033,850	51.7	12.7
1967	465,255	501,741	383,591	954,064	729,401	52.6	9.1
1968	617,541	627,961	525,566	1,204,621	1,008,195	52.1	10.7

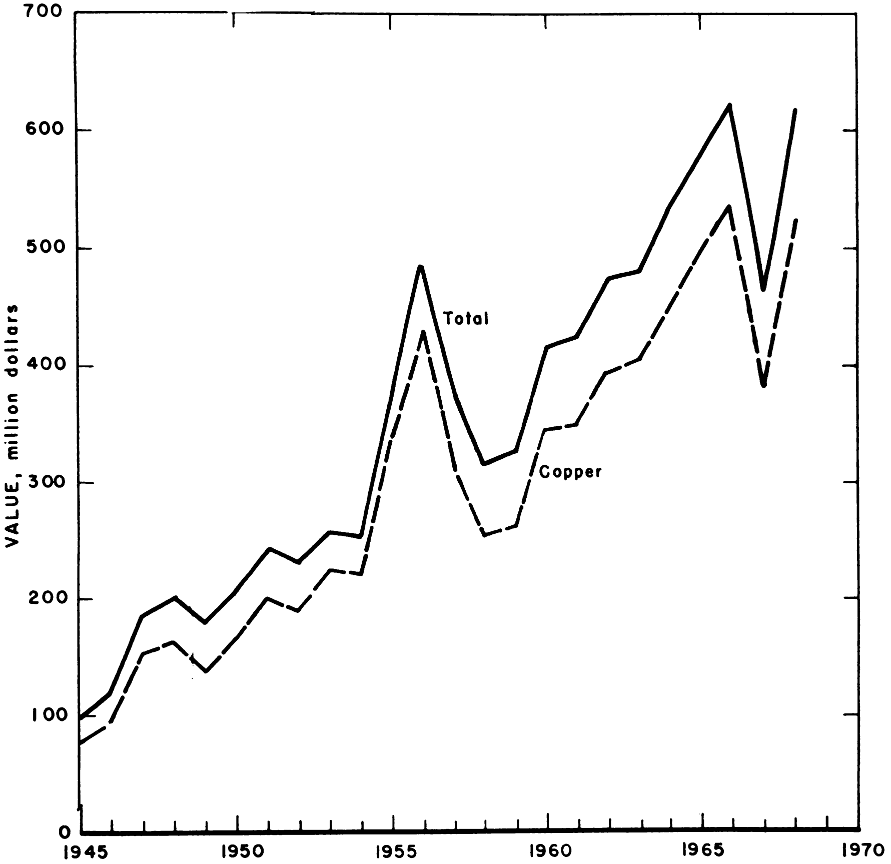

Figure 1.—Value of mine production of copper, and total value of mineral production in Arizona.

leach-material stripping ratios (the ratio of waste and leach material to ore) at the nine major properties ranged from a low of 1.02 to 1 at the Inspiration Consolidated Copper Co. Inspiration mine in the Globe-Miami mining district in the central part of the State, to a high of 4.48 to 1, at the Lavender Pit mine at Bisbee. The ratio of waste to leach material at nine of the larger open-pit mines was 1.29 to 1.

Approximately 22.1 percent of the waste material removed in the State during the year was from The Anaconda Company Twin Buttes property.

Operations at the Phelps Dodge Corp. open-pit and underground mines at Morenci, Ajo, and Bisbee were resumed on March 19, after settlement of the nationwide strike. The open-pit mines were operated on the equivalent of a 6½-day week; the underground mine at Bisbee, on a 6-day week.

The Morenci open-pit mine operated by the company was the State's leading producer, yielding 42.8 million tons of material: 15.5 million tons was ore, and 27.3 million tons was waste and leach material.[7] Production of copper from all sources (milling and leaching of copper ores and leach dumps) totaled 106,857 tons, com-

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[7] Phelps Dodge Corp. Annual Report 1968, p. 10.

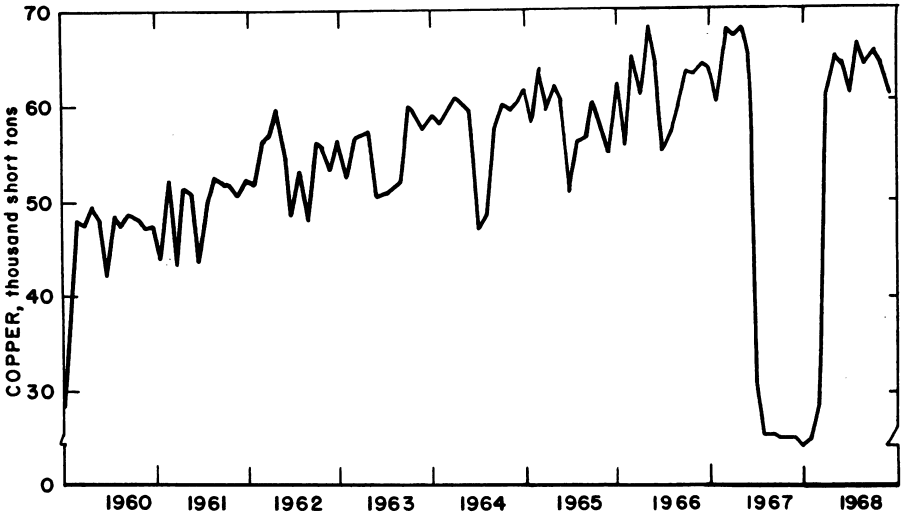

Figure 2.—Mine production of copper in Arizona by months, in terms of recoverable metals.

Table 6.—Fifteen leading copper producing mines in 1968, in order of output

Rank in 1968	Rank in 1967	Mine	District	County	Operator	Source of copper in 1968
1	1	Morenci	Copper Mountain	Greenlee	Phelps Dodge Corp.	Copper ore, copper precipitates, gold-silver ore.
2	2	San Manuel	Old Hat	Pinal	Magma Copper Co.	Copper ore.
3	3	Pima	Pima	Pima	Pima Mining Co.	Do.
4	5	New Cornelia	Ajo	do	Phelps Dodge Corp.	Copper ore, gold-silver ore.
5	4	Ray	Mineral Creek	Pinal	Kennecott Copper Corp.	Copper ore, copper precipitates.
6	7	Copper Queen, Lavender Pit	Warren	Cochise	Phelps Dodge Corp.	Do.
7	6	Mission	Pima	Pima	American Smelting and Refining Co.	Copper ore.
8	8	Inspiration	Globe-Miami	Gila	Inspiration Consolidated Copper Co.	Copper ore, copper precipitates.
9	9	Mineral Park	Wallapai	Mohave	Duval Corp.	Do.
10	10	Silver Bell	Silver Bell	Pima	American Smelting and Refining Co.	Do.
11	11	Esperanza	Pima	do	Duval Corp.	Do.
12	12	Bagdad	Eureka	Yavapai	Bagdad Copper Corp.	Do.
13	13	Copper Cities	Globe-Miami	Gila	Miami Copper Co.	Do.
14	14	Magma	Pioneer	Pinal	Magma Copper Co.	Copper ore.
15	15	Christmas	Banner	Gila	Inspiration Consolidated Copper Co.	Do.

Table 7.—Ore mined, waste material removed, leach material placed in dumps, and total copper production at principal copper open-pit and underground mines

Mine	Ore mined (thousand short tons)		Waste material removed (thousand short tons)		Leach material placed in dumps (thousand short tons)		Total copper produced from all sources [1] (short tons)	
	1967	1968	1967	1968	1967	1968	1967	1968
OPEN PIT								
Morenci	11,052	15,474	9,588	13,788	8,605	13,527	82,034	106,857
Pima	9,900	13,000	[2] 21,203	[2] 17,871	--------	--------	[3] 46,500	[3] 61,500
New Cornelia	6,078	9,018	9,601	16,774	--------	--------	40,118	58,544
Ray	4,948	6,746	[4] 9,362	[4] 18,745	([5])	([5])	[6] 46,670	[6] 58,030
Mission	4,604	6,010	14,331	16,120	--------	--------	[3] 36,746	[3] 39,144
Inspiration	4,014	6,167	4,449	3,595	683	2,719	27,126	34,862
Mineral Park	5,632	6,233	9,308	6,284	2,855	5,183	[6] 27,143	[6] 28,704
Silver Bell	3,812	3,923	3,652	5,376	5,529	2,242	[6] 22,960	[6] 24,999
Lavender Pit	3,176	4,715	8,351	14,439	5,583	6,706	19,686	24,701
Esperanza	4,977	5,480	3,677	1,105	5,071	6,494	[6] 23,911	[6] 24,413
Bagdad	2,091	2,099	5,530	4,524	2,642	3,325	[6] 18,645	[6] 19,073
Copper Cities	2,430	3,359	284	292	4,374	5,579	[6] 12,924	[6] 17,284
Christmas	857	1,173	3,076	6,005	--------	--------	4,494	7,641
UNDERGROUND								
San Manuel	7,892	11,368	--------	--------	--------	--------	53,963	72,074
Copper Queen	386	623	--------	--------	--------	--------	14,436	22,605
Magma	220	334	--------	--------	--------	--------	9,550	14,706

[1] Includes copper recovered from leaching of material in place and in dumps.
[2] Thousand cubic yards.
[3] Gross metal content in concentrates shipped.
[4] Total of waste and leach material; breakdown unavailable.
[5] Included with waste material; breakdown unavailable.
[6] Gross metal content in concentrates and precipitates shipped.

Source: Company-published annual reports or Bureau of Mines data.

Table 8.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals [1]

Year	Mines producing		Material sold or treated [2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1964	85	1	86,742	153,676	$5,379	5,811	$7,513
1965	92	2	93,466	150,431	5,265	6,095	7,881
1966	92	1	102,068	142,528	4,988	6,339	8,196
1967	76	1	74,742	80,844	2,830	4,588	7,112
1968	87	1	101,565	95,999	3,769	4,958	10,633
1890–1968	NA	NA	NA	13,640,412	365,319	403,051	336,422

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1964	690,988	$450,524	6,147	$1,611	24,690	$6,716	$471,743
1965	703,377	497,991	5,913	1,845	21,757	6,353	519,335
1966	739,569	535,004	5,211	1,575	15,985	4,636	554,399
1967	501,741	383,591	4,771	1,336	14,330	3,967	398,835
1968	627,961	525,566	1,704	450	5,441	1,469	541,887
1890–1968	22,351,299	10,270,572	651,305	129,027	1,020,795	249,155	11,350,495

NA Not available.

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings, or slimes re-treated, and ore, old tailings, or copper precipitates shipped to smelters during the calendar year indicated.

[2] Does not include gravel washed or tonnage of precipitates shipped.

Table 9.—Mine production of gold, silver, copper, lead, and zinc in 1968, by counties, in terms of recoverable metals

	Mines producing [1]		Material sold or treated [2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
Cochise	10	---------	5,374	24,125	$947	547,970	$1,175
Coconino	---------	---------	[3] 251	---------	---------	[3] 8,224	[3] 18
Gila	10	---------	14,228	3,948	155	215,580	462
Graham	1	---------	(3)	---------	---------	(3)	(3)
Greenlee	1	---------	15,474	9,419	370	518,992	1,113
Maricopa	6	---------	(4)	46	2	149	(4)
Mohave	6	1	6,357	134	5	594,579	1,275
Pima	12	---------	37,534	29,260	1,149	2,008,323	4,307
Pinal	14	---------	18,496	23,491	922	785,481	1,685
Santa Cruz	3	---------	(3)	(3)	(3)	(3)	(3)
Yavapai	18	---------	3,533	5,576	219	259,146	556
Yuma	6	---------	318	---------	---------	19,718	42
Total:							
1968	87	1	101,565	95,999	3,769	4,958,162	10,633
1967	76	1	74,742	80,844	2,830	4,588,081	7,112

	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Cochise	47,686	$39,910	19	$5	155	$42	$42,079
Coconino	[3] 156	[3] 131	[3] 11	[3] 3	[3] (4)	[3] (4)	[3] 151
Gila	69,837	58,450	---------	---------	---------	---------	59,067
Graham	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Greenlee	106,858	89,433	---------	---------	---------	---------	90,916
Maricopa	4	4	---------	---------	---------	---------	6
Mohave	28,636	23,967	3	1	44	12	25,260
Pima	207,418	173,596	14	4	332	90	179,146
Pinal	143,270	119,908	1	(4)	---------	-------	122,515
Santa Cruz	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Yavapai	21,706	18,167	1,639	433	4,909	1,325	20,700
Yuma	2,390	2,001	17	4	1	(4)	2,048
Total:							
1968 [5]	627,961	525,566	1,704	450	5,441	1,469	541,887
1967	501,741	383,591	4,771	1,336	14,330	3,967	398,835

[1] Operations at slag dumps and old mill or miscellaneous cleanups not counted as producing mines; also excludes count of uranium mine from which copper and silver were recovered as byproducts.

[2] Does not include tonnage of gravel washed, of precipitates shipped, or uranium ore milled.

[3] Coconino, Graham, and Santa Cruz Counties combined to avoid disclosing individual company confidential data.

[4] Less than ½ unit.

[5] Data may not add to totals shown because of independent rounding.

pared with 82,034 tons in 1967. Ore and waste were mined at an average daily rate of 162,000 tons. The ratio of waste and leach material to ore was 1.77 to 1, compared with 1.65 to 1 in 1967 and 1.49 to 1 in 1966. The extension of the mine into the townsite continued.

Construction began late in the year on a $10.7 million expansion and improvement program at Morenci, Ajo, and Bisbee. Additions and improvements to the Morenci smelter will enable it to treat a substantial part of the concentrates to be produced at Phelps Dodge Corp.'s new mine at Tyrone, N. Mex. Principal additions include a new 600-foot concrete smelter stack to improve the draft on the converters, another converter and holding vessel, modifications to the smelter crushing facilities, and another turbine in the powerplant to meet increasing power requirements. To eliminate dust emissions, an electrostatic dust precipitator will be installed in the new stack.

Included in the construction is a 4.5-mile aerial tramway to transport limestone from a new quarry to the smelter. The new quarry, located above Clifton near the San Francisco River, will require a surface haul of 8 to 10 miles. The tramway will take the direct route, crossing over Chase Creek Canyon between Clifton and the horseshoe bend in the highway going up to Morenci.

Operations were continued at the Copper Queen Branch near Bisbee. Consisting of the Copper Queen underground mine and the Lavender open pit, these two properties yielded 623,000 and 4.7 million tons of ore, respectively. In addition, approximately

Table 10.—Mine production of gold, silver, copper, lead, and zinc in 1968, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (thousand short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode ore:							
Dry gold	1	(2)	68	65	1	--------	--------
Dry gold-silver	6	60	109	3,441	1,004	--------	--------
Dry silver	21	44	6	35,800	234	17	--------
Total [3]	28	104	183	39,306	1,238	17	--------
Copper	44	101,294	89,419	4,697,394	1,146,314	--------	754
Copper-zinc	2	22	4	6,175	1,076	3	3,212
Lead	6	(2)	--------	2,999	3	90	1
Lead-zinc	2	99	5,274	186,506	161	3,270	6,886
Zinc	2	(2)	--------	89	(2)	2	28
Total [3]	56	101,415	94,697	4,893,163	1,147,554	3,366	10,880
Other "lode" material:							
Gold-silver tailings	1	23	854	11,920	56	--------	--------
Silver tailings	1	22	135	7,909	72	--------	--------
Copper cleanup	(4)	1	54	1,633	261	--------	--------
Copper precipitates	15	79	--------	----------	106,605	--------	--------
Lead cleanup, lead tailings, and uranium ore [5]	[6] 1	(2 7)	72	4,231	136	24	2
Total [3]	18	125	1,115	25,693	107,129	24	2
Total "lode" material	87	101,644	95,995	4,958,162	1,255,922	3,408	10,882
Placer	1	--------	4	----------	----------	--------	--------
Total all sources	88	101,644	95,999	4,958,162	1,255,922	3,408	10,882

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Less than ½ unit.
[3] Data may not add to totals shown because of independent rounding.
[4] From properties not classed as mines.
[5] Combined to avoid disclosing individual company confidential data.
[6] Excludes properties not classed as mines and the count of uranium mine from which copper and silver were recovered as byproducts.
[7] Excludes uranium ore tonnage.

Table 11.—Mine production of gold, silver, copper, lead, and zinc in 1968, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Concentration and smelting of concentrates:					
Ore [1]	90,515	4,790,919	[2] 1,117,082	3,309	10,874
Old tailings	2	272	(3)	5	1
Total	90,517	4,791,191	1,117,082	3,314	10,875
Direct smelting:					
Ore	4,365	144,095	15,356	82	7
Cleanup	124	3,047	261	12	----------
Precipitates	----------	----------	106,605	----------	----------
Old tailings	989	19,829	128	----------	----------
Total [4]	5,478	166,971	122,349	94	7
Other: Leaching of copper ore	----------	----------	16,490	----------	----------
Placer	4	----------	----------	----------	----------
Grand total [4]	95,999	4,958,162	1,255,922	3,408	10,882

[1] Includes concentrate from uranium ore.
[2] Includes copper recovered from leaching of ore at operations that employ "dual-process" treatment of leaching followed by flotation concentration.
[3] Less than ½ unit.
[4] Data may not add to totals shown because of independent rounding.

21.0 million tons of waste and leach material were removed from the Lavender pit. The ratio of waste and leach material to ore mined in 1968 was approximately 4.48 to 1, compared with 4.38 to 1 in 1967. The increase in stripping ratio resulted primarily from development work connected with the extension of the pit, begun in 1966.

The copper concentrator at the Lavender pit treated 4.7 million tons of ore at an average rate of 18,000 tons of ore per operating day. Part of the ore from the underground mine was shipped to the company smelter at Douglas; part was treated at the Lavender concentrator.

No important new ore bodies were discovered at the underground mines at Bisbee; the tonnage of new ore developed nearly equaled the tonnage mined.

Forty miles east of Bisbee, the company smelter at Douglas treated ores and copper precipitates from the Copper Queen underground mine, concentrates from the Lavender pit concentrator, and copper precipitates from the Lavender pit. Copper scrap and other copper-bearing material were treated on a custom or toll basis at the smelter.

Production of copper from the New Cornelia Branch mine near Ajo was 58,544 short tons; ratio of ore to waste mined in the Ajo open pit was 1.86 to 1.

Inspiration Consolidated Copper Co., a major producer of copper products in the Globe-Miami area, continued the modernization and expansion program begun in 1966. Major elements in this program include activation of the new continuous melting, casting, and rod rolling mill; beginning of operations at the Ox-Hide mine; and inception of stripping operations in the development of the Red Hill mine.

The company's Inspiration Division mined and treated 6.2 million tons of ore at an average daily rate of 22,426 tons. The ratio of waste to ore in 1968 was 1.02 to 1, compared with 1.28 to 1 in 1967.

Copper was recovered by acid leaching of waste dumps and mined-out areas, followed by precipitation of copper from solutions by scrap iron. Production for the year was 6.4 million pounds, compared with 3.5 million pounds in 1967. The quantity of copper recovered from this type of operation is expected to increase when facilities for leaching a dump at the Live Oak mine are completed in 1969.

In-plant leaching and electrowinning of copper from leach solutions resulted in 12 million pounds of cathode copper from the electrolysis of strong leach solutions and 16.1 million pounds by the precipitation of copper from weak solutions in the form of cement copper. Part of the cement copper was sold for use in powder metallurgy or chemical applications; the balance was smelted and refined.

During the year the concentrator treated 2.5 million tons of previously leached ore and 2.6 million tons of sulfide ore at an average daily rate of 18,853 tons. In addition, 1,135 tons per day of fine ore particles removed from the ore stream to facilitate leaching-plant operations were separately treated.

The smelter treated an average of 830 tons per day of concentrates, precipitates, and other materials, compared with 786 tons in 1967.

Refinery operations were conducted at capacity during that period not affected by the strike. Average daily output of refined copper during the operating period was 345,543 pounds in 1968, compared with 358,420 pounds in 1967.

Open-pit operations at the company's Ox-Hide mine, 4 miles west of Miami, were begun during the third quarter. The ore was broken by tractor-mounted rippers, generally without blasting, and transported by self-loading power scrapers to prepared impermeable leaching pads. Mining, begun at a rate of 6,000 tons of ore per day, is being increased to 12,000 tons. Recovery from the ore, to be treated by heap leaching, will be about 3.8 pounds of copper per ton of ore mined.

Stripping began at the Red Hill mine on September 19; ore production will start in 1973. By yearend, 1.3 million tons of waste had been removed. The ore will supplement production from the Thornton and Live Oak pits.

Open-pit operations at Inspiration's Christmas mine and concentrator were significantly improved during the year. This operation differs from other company open-pit operations in that all ore is handled by large front-end loaders rather than power shovels. The mill operation is somewhat unique; flotation, generally applicable only to sulfide ores, also recovers a substantial part of the oxide values.

Known ore reserves at the Christmas mine are adequate for about 10 years of operation; prospects for developing additional ore are good.

The Bagdad mine, Bagdad Copper Corp., principal source of copper in Yavapai County, was ranked 19th largest in the Nation. The company produced 18,645 tons of copper. Recovery of copper from sulfide ores was 22.2 million pounds, 13 percent below the 25.7 million pounds reported in 1967. The average grade of ore mined during the year was 0.65 percent, compared with 0.77 percent in 1967. The 13 percent decline in output was attributed to the lower grade of ore mined.

Drilling at the property adjacent to the present ore body defined an additional 141 million tons of ore with an average grade of 0.52 percent copper; stripping ratio is about 2 to 1.

The combined ore reserves of the two properties is 185 million tons, averaging 0.56 percent copper. The cumulative grade is too low to be treated economically with the present mining and milling facilities. Hence, studies are currently under way to determine the possibilities of constructing a 20,000-ton-per-day mining and milling facility.

Miami Copper Co. Division, Tennessee Corp. (a subsidiary of Cities Service Co.), recovered copper from its Copper Cities mining, milling, and leaching operations. Ore was leached in place at the Miami underground mine; low-grade dump material was leached at Castle Dome.

Contracts were awarded to Stearns-Roger Corp. for engineering and construction of surface facilities required to expand daily production at San Manuel Division, Magma Copper Co., from 40,000 to 60,000 tons of ore. A contract was also awarded to Cementation Company of America for sinking two new circular concrete shafts. Shaft sinking is under way. The 22-foot-inside-diameter No. 3–C shaft, to be approximately 2,900 feet deep, is scheduled for completion by July 31, 1970. Scheduled for completion by October 31, 1971, the No. 5 shaft, 25 feet inside diameter, will be approximately 3,600 feet deep. Fully expanded production is expected early in 1971 before completion of the No. 5 shaft.

In 1968 San Manuel Division mined 11.4 million tons of ore assaying 0.701 percent sulfide copper, compared with 7.9 million tons assaying 0.758 percent sulfide copper in 1967. Ore mined per operating day averaged 39,840 tons in 1968, compared with 41,463 tons in 1967. Copper recovered per ton of ore mined declined from 13.68 pounds in 1967 to 12.68 pounds in 1968. The drop in average daily production was caused by difficulties encountered in moving wet, sticky ore that had absorbed moisture during the 8½-month strike. The lower grade of ore mined was the result of the normal sequence of blocks under production being from areas of lower-than-average grade. The company quarried 48,337 tons of limestone and 8,229 tons of quartzite for metallurgical purposes.

The San Manuel concentrator milled 11.3 million tons of ore at an average rate of 39,654 tons per operating day. Approximately 86 percent of the total copper and 93 percent of the sulfide copper were recovered. The San Manuel smelter processed 255,094 tons of concentrates assaying 29.08 percent copper; 183,460 tons of concentrates assaying 29.88 percent were smelted in 1967. Metal production was 72,100 tons of copper, 2,300 tons of molybdenum sulfide, 14,300 troy ounces of gold, and 245,316 ounces of silver.

At the Magma mine near Superior, Superior Division, Magma Copper Co., continued developing the upper limestone beds. This increased total ore reserves to 10.0 million tons averaging 5.9 percent copper and resulted in expanding daily production capacity from 1,500 to 3,000 tons. Feasibility studies conducted by the company indicated that the cost of producing copper should be substantially reduced by modernizing the mine, establishing new entries, and expanding plant facilities to mine and mill 3,000 tons per day. The expansion program includes establishing a new mine plant site approximately 9,200 feet east of the present site; sinking a new, circular, 22-foot-diameter, concrete-lined shaft to a depth of 4,800 feet below the collar; extending the ore-haulage drift to the new shaft; enlarging the mill; converting the electric equipment from 25- to 60-cycle power supply; and abandoning the smelter. Completion of the shaft and surface facilities is expected by the end of 1972; full capacity is anticipated about 1974.

In 1968 Superior Division mined and milled 333,607 tons of ore containing 4.63 percent copper, 0.024 ounce of gold, and 1.11 ounces of silver per ton, compared with 219,510 tons of ore containing 4.77

percent copper, 0.026 ounce of gold, and 1.01 ounces of silver per ton in 1967. The company produced 14,706 tons of copper, 7,263 ounces of gold, and 347,119 ounces of silver.

Continuing development work to bring a new open-pit mine into production at Twin Buttes, The Anaconda Company expects production of copper concentrate to begin late in 1969. Primary crushers were installed in the mine during the year, and a second system of conveyor belts to handle rock began operating. Crews have begun to mine the first rock, some of which is ore. Lower transportation costs have been achieved in removing rock from the pit by conveyor than by use of conventional methods of long-distance hauling.

The Mission open-pit mine operated by Asarco, 22 miles southwest of Tucson, resumed normal operations in April following the conclusion of the 8½-month copper strike. The company mined and milled 6 million tons of ore at an average daily rate of 22,500 tons of ore. The mill recovered 144,547 tons of concentrates containing 39,144 tons of copper and 495,684 ounces of silver.

At the company's San Xavier lease, 1.5 miles north of the Mission mine, 831,900 tons of waste material were stripped and 41,873 tons of copper-bearing siliceous ore were produced for use as converter flux at company smelters.

The Silver Bell mine and mill of Asarco was operated at full capacity during the year, producing 83,331 tons of concentrates containing 22,520 tons of copper and 223,086 ounces of silver. In addition, 2,479 tons of copper in precipitates were produced.

Plant construction and pre-mining stripping of overburden continued at Duval Sierrita Corp.'s property 35 miles southwest of Tucson. Located adjacent to Duval Corp.'s Esperanza open-pit copper-molybdenum property, the property is estimated to contain in excess of 414 million tons of low-grade copper-molybdenum ore averaging 0.35 percent copper and 0.36 percent molybdenum. Approximately 105 million tons of waste material must be removed to prepare the mine for a daily ore production of 72,000 tons. During the first 5 years, waste to ore ratios will average 2.25 to 1, 1.68 to 1 for the next 5 years, and 0.59 to 1 thereafter. At yearend 54.9 million tons of waste had been removed. Twelve shovel shifts are removing 200,000 tons of overburden per day. All mine-plant facilities are operational. Totaling 1.3 million cubic yards, all major mill excavation has been completed. Concrete emplacement neared completion in the coarse-ore reclaim facility and the secondary and tertiary crushers foundations. Substantial concrete has been poured for mill-building foundations, floor slabs, and walls. Erection of steel in the grinding-bay section of the mill building began November 18. Other structures that have been or were nearly completed at the end of the year include the machine, carpenter-electric shops; the administrative office; and employees' change room. Construction of a 9.7-mile railroad spur was completed in November. Some 8 miles from the plant site, six water wells have been or are being drilled to produce 15,000 gallons per minute in a new water field along the Santa Cruz River. Excavation for two primary crushers near the pit perimeter has been completed; concrete emplacement is well under way.

The Sierrita property is to begin production by November 1, 1969, with the designed daily milling capacity of 72,000 tons of ore being achieved within 6 months. Over the life of the property production is expected to exceed 2.6 billion pounds of copper, 238 million pounds of molybdenum, and 9 million ounces of silver.[8]

Pima Mining Co. (50 percent owned by Cyprus Mines Corp.) achieved continuity of production during the copper industry strike through a 3-year labor agreement made in 1967. During 1968 Pima mined and milled 13 million tons, compared with 9.9 million tons in the preceding year. The actual operating rate was 36,000 tons of ore per day. Flotation concentrate production contained 123 million pounds of marketable copper, compared with 93 million pounds in 1967. Also recovered at the concentrator was 1.5 million pounds of contained molybdenum in concentrate; the molybdenum circuit was added to the concentrator in 1967.

Eight primary smelters were operated in the State, principally on concentrates, precipitates, and ores produced by the company operating the smelter. Four of the smelters—Phelps Dodge Corp. at Douglas,

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[8] Jancic, Thomas. Development Well Along on Multi-Million-Dollar Duval Sierrita Mine. Pay Dirt, No. 354, Dec. 30, 1968, pp. 8–10.

Inspiration Consolidated Copper Co. at Inspiration, Magma Copper Co. at Superior, and Asarco at Hayden—also treated ores on a custom or toll basis. Phelps Dodge Corp., with smelters at Ajo, Douglas, and Morenci, accounted for 57 percent of the total smelting capacity within the State; Magma Copper Co., with smelters at San Manuel and Superior, accounted for 13 percent. The smelters operated by Kennecott Copper Corp. and Asarco at Hayden and by Inspiration Consolidated Copper Co. at Inspiration each accounted for 10 percent.

Approximately 2.8 million tons of ore, concentrates, and precipitates were shipped to smelters in or outside the State. These shipments consisted of 2.5 million tons (88.2 percent) of the concentrates obtained from the milling of copper ores; 248,228 tons of direct shipping ores (8.8 percent); and 85,573 tons (3.0 percent) of precipitates from leaching ores in dumps, in place, in vats, and in heaps.

Leaching.—Leaching of copper from mine waste has been more art than science. Long considered a bonus to the miner, the recovery of copper from mine waters and dump-leaching solutions received little engineering study. In recent years, however, the process of leaching submarginal rock and underground workings has received considerable attention; the quantity of copper derived from this source has increased significantly.

Three principal methods are used in recovering copper from lean ores: leaching in place, dump leaching, and vat leaching. Leaching in place has been successfully applied at the Copper Queen, Inspiration, Miami, and Ray mines. Dump and vat leaching have been used at a number of locations.

Bagdad Copper Corp. reported recovering 15.0 million pounds of copper from leaching waste dumps at its copper mine, 50 miles west of Prescott. The 29 percent increase in output resulted from the first full year of leaching of a new ore pile at the property. To achieve a greater recovery of copper from leaching, the company plans, by the end of 1970, to install a solvent-extraction plant to treat leach solutions and produce commercial copper cathodes. Use of the solvent-extraction process is expected to extend materially the life of the leach dump through the elimination of iron buildup.

Cement copper recovered from the leaching of ore and waste dumps, in vats, and in place at 21 operations contained 61,547 short tons of recoverable copper. The copper content of the precipitates ranged from a low of 20.2 percent copper to a high of 84.7 percent, averaging 71.3 percent. Copper produced by precipitation from mine-water and leach solutions comprised 9.8 percent of the total output of copper.

At Ray Mines construction of a plant to treat 10,000 tons of silicate copper ore daily neared completion; the first silicate ore was scheduled to be placed in the vats early in 1969. The operation will increase annual production by 24,000 tons. Also at Ray a new facility to produce 750 tons daily of sulfuric acid from sulfur dioxide gas went on stream late in the year. Scheduled for completion early in 1969, construction of a new cone precipitation plant was begun at Ray during the year. The facility will permit treatment of larger volumes of lower grade copper-bearing solutions. New concentrate-handling facilities at the smelter were under construction.

Completed in March the solvent-extraction-electrowinning copper facility constructed at the Bluebird mine by Bechtel Corp., for Ranchers Exploration and Development Corp., was operating near designed capacity at yearend. Lower production during the shakedown period, while the cement-copper operation was being phased out, reduced output for the year. Also affecting production were flooding and severe winter conditions. Exceeding 99.9 percent purity, the cathodes produced in the plant require no further refining and are thus shipped directly to fabricators.

Gold.—Output of gold from 41 lode deposits and one placer deposit totaled 96,000 troy ounces; 89,419 ounces, 93 percent, were recovered as a byproduct of copper refining; 5,274 ounces, 5 percent, from the smelting of lead-zinc ores; and the balance from gold, gold-silver, silver, and other base-metal ores and miscellaneous lode material.

Phelps Dodge Corp. reported that 71,000 ounces of gold was recovered from refining copper ore produced at Morenci, New Cornelia, and Copper Queen mines. Production of gold by Magma Copper Co. at the Superior and San Manuel Divisions totaled 21,566 ounces.

Shattuck Denn Mining Corp. (McFarland & Hullinger, lessee), third leading producer in the State, ceased operations at the Iron King mine in Yavapai County.

Pima was the leading gold-producing county, followed in order by Cochise and Pinal. Other counties having production were Gila, Greenlee, Maricopa, Mohave, and Yavapai.

Iron Ore.—Shipments of usable iron ore were 5 percent below those of the previous year. Direct-shipping hematite ore was produced and shipped by CF&I Steel Corp. from the Apache pit in Navajo County and by Chas. Pfizer & Co., Inc., from the Cowden pit in Yavapai County. Sovereign Industries, Inc., recovered magnetite from the Black Mountain mine near Florence.

Sponge iron was produced by Ray Mines at Hayden and by Phelps Dodge Corp. at Douglas from iron oxides recovered from smelting.

Lead.—Production of lead declined 64 percent. McFarland & Hullinger entered into a lease-purchase agreement with Shattuck Denn Mining Corp. and operated the property until December 1968 when they determined that the economically minable ore body had been depleted. The lease-purchase agreement was terminated, and the remaining buildings, machinery, and equipment—except the main office building, the Superferrite operation, and the tailings pond—were sold.

Mercury.—Output of mercury from three mines in the Mazatzal Mountains in Gila and Maricopa Counties was 192 76-pound flasks valued at $103,000.

The mercury content of ores mined in the State, derived mostly from open pits, ranged from 0.05 to 0.33 percent, averaging 0.05 percent. The average value of the crude ore treated was $6.43 per ton. Almost all of the ore was furnaced. The National mine, Maricopa County, operated by Greater Denver Phoenix Mining Co. and by Phoenix Sunflower Industries, Inc., led in production, followed in order by the Sunflower mine, Maricopa County, operated by Posey Mining Co., and the Lola Lee mine operated by Jack Ralston, Gila County. Most of the mercury was purchased by S.S.T. Corp.

Molybdenum.—Arizona accounted for 13 percent of the total United States molybdenum production. A byproduct in the processing of copper ores, output was limited by the strike at the facilities of the major copper producers. Six of the State's 11 conversion plants were closed by strikes from the first of the year to the latter part of March.

Output of molybdenite concentrate (MoS_2) in the State was 21.6 percent above that of 1966, the last full year of production, and 30 percent above that of 1967. The increase from 1966 was due to the addition of three producers—Miami Copper Co. and Pima Mining Co. in 1967 and Ray Mines in 1968.

More than 73.1 million tons of copper ores containing 0.001 to 0.059 percent MoS_2 were processed to recover 1.6 million tons of copper concentrates. Further processing by selective flotation resulted in the production of 11,300 short tons of molybdenite concentrate containing approximately 12.1 million pounds of molybdenum (Mo). The molybdenum content of the concentrates ranged from 39.8 to 56.0 percent, averaging 53.9 percent. Shipments totaled 11,250 short tons of concentrates containing 12.1 million pounds of Mo valued at $19.2 million. Of this total, 88 percent entered the domestic market; 12 percent was exported. Stocks of MoS_2 concentrate on hand December 31, 1968, totaled 210 short tons, compared with 173 short tons at the end of 1967. The average price received for molybdenum in concentrate form was $1.58 per pound, compared with $1.66 per pound in 1967.

Silver.—The high level of silver prices generated by uncertainties about world currencies and by rumors that the Treasury would be unable to continue its weekly sales through the General Services Administration, prompted considerable activity at silver-bearing properties and exploration throughout the State. Exploration activity was reported in Cochise, Gila, Mohave, Pima, Santa Cruz, Yavapai, and Yuma Counties.

Primarily because of termination of the copper strike, silver production increased 8 percent above the 1967 level. Byproduct silver from copper mines accounted for 4.7 million ounces, 95 percent, of the total silver produced; lead-zinc ores accounted for most of the remainder.

Magnum Mining Co. proceeded with development work at the McCracken silver-lead property in Mohave County. The property was mined by underground methods in the past, but the company is considering an open-pit operation. A preliminary report in November 1967 estimated reserves at 1.3 million tons of ore containing 6.56 ounces of silver and 1.62 pounds of lead per ton.

Tungsten.—Small quantities of tungsten concentrates (60 percent WO_3) were recovered from processing tungsten ores mined at three properties. The average grade of the 89 tons of ore mined was 0.92 percent WO_3.

Uranium.—Production (recoverable content U_3O_8) increased from 83,000 pounds to 295,000 pounds in 1968, and value increased from $666,000 to $1.9 million. Shipments of crude ore, from seven operations in two counties, to processing plants at Canon City, Colo., and at Grants and Shiprock, N. Mex., totaled 44,171 short tons valued at $1,395,688, f.o.b. mine value (AEC Circular 5, Revised, price schedule). The f.o.b. value of the ore produced ranged from $4.84 for crude ore containing 0.11 percent uranium oxide (U_3O_8) to $41.65 per ton for crude ore containing 0.47 percent U_3O_8. The average grade of ore shipped from the mines was 0.37 percent U_3O_8, only slightly below that shipped in 1967. The average value of mine shipments was $31.60.

Vanadium.—Uranium ores in Apache County contained sufficient quantities of vanadium to warrant recovery.

Zinc.—Ores from two lode mines in Yavapai County yielded 90 percent of the recoverable zinc produced in the State. Output declined 62 percent in quantity and 63 percent in value because of the lower output at the Iron King mine.

Old Dick Division, operating as Old Dick Mining and Timber Co., Cyprus Mines Corp., completed work on deepening the Bruce shaft and began exploration to develop and delineate new ore reserves. Although the mine has not been completely explored, sufficient work was completed to indicate that the ore reserves will support mill production at a capacity of 9,000 tons per month for about 3 years. Production began the latter part of the year, and during 1969 the Bruce mine is expected to be producing at full capacity of 2,500 tons of copper and 9,000 tons of zinc.

NONMETALS

Asbestos.—Chrysotile asbestos fiber was produced from underground mines in Gila County by three companies: Asbestos Manufacturing Co., Jaquays Mining Corp., and Metate Asbestos Corp. Jaquays Mining Corp., the State's major producer, prepared and shipped Crude No. 1, 3Z filter, 5K shorts, 7MF shorts, and sand and waste. Other producers included Metate Asbestos Corp., which prepared and shipped LZ–222 filter and No. 7 shorts from the Lucky Seven mine, and Asbestos Manufacturing Co., which prepared and shipped 3Z filter and 5K shorts and waste from the Phillips mine. Most of the processed material was used in manufacturing products used by the construction industry.

Cement.—The quantity and value of portland and masonry cement shipments increased substantially. Output was by Arizona Portland Cement Co. Division, California Portland Cement Co., at its Rillito plant in Pima County, and by Phoenix Division, American Cement Corp., at its Clarkdale plant in Yavapai County. Virtually all output was used within the State; less than 0.5 percent was exported.

Of the total portland cement shipped, 78 percent was transported by truck and 22 percent by rail. The ratio of bulk to paper-bag shipment was about 9 to 1. Eighty-two percent was distributed to firms manufacturing commercial concrete products, such as ready-mixed-cement companies (70 percent) and concrete-product manufacturers (12 percent). The other 18 percent was sold to building-material dealers (8 percent), highway and other contractors (8 percent), Government agencies (1 percent), and miscellaneous customers (less than 0.5 percent).

Raw materials used in manufacturing cement included limestone, clay, gypsum, blast-furnace slag, resin, lime, and asbestos; other compounds are given under the appropriate commodity section.

Clays.—Miscellaneous clay and shale sold or used by producers declined 27 percent, whereas bentonite clay output increased. Miscellaneous clay and shale for manufacturing building brick was mined by Phoenix Brick Yard at the Tolleson pit and by Wallapai Brick & Clay Products, Inc., in Maricopa County; by Grabe Brick Co., Inc., Phoenix Brick Yard, and Tucson

Pressed Brick Corp., all at the Pantano pits in Pima County. American Cement Corp. produced clay at its Lakebed pit in Yavapai County for manufacturing cement.

Bentonite production was largely by Filtrol Corp. from the Cheto pit. Two other firms, Arizona Gypsum Corp. and McCarrell & Gurley, were also active. Bentonite produced by Filtrol Corp. was used in filtering and decoloring mineral and vegetable oils. McCarrell & Gurley produced bentonite from the Cheto No. 1 pit in Apache County and shipped the material for use as an absorbent. A small quantity of bentonite was produced near Camp Verde, Yavapai County, by Arizona Gypsum Corp., and shipped for use as a binder in pelletizing. Kaolin mined by Franconia Mining Corp. from the Klaner and Doolin pits near Franconia, Mohave County, was sold for manufacturing refractory products. Increased demand for clay products manufactured by McKusick Mosaic Co. resulted in a higher output of fire clay from the Weary Lode in Gila County.

Diatomite.—From its White Cliffs property near Mammonth, Pinal County, Arizona Gypsum Corp. mined, prepared, and sold a small quantity of crude diatomite for use as a filler.

Feldspar.—Although the tonnage of marketable feldspar sold or used was 5 percent below that of 1967, the value was 3 percent higher. Industrial Minerals Division, International Minerals & Chemical Corp. (IMC), was the only producer of crude and ground feldspar in the State. All of the crude potash feldspar mined by a contractor for IMC from pegmatite deposits at the Taylor mine was ground in the company mill near Kingman and used in manufacturing enamel and pottery. Most of the ground material was shipped to out-of-State buyers, primarily in California.

Gypsum.—Production of crude gypsum from four mining operations—three in Pinal County and one in Yavapai County—totaled 15 percent more than that produced for the previous year. The increased output was primarily attributed to the greater demand for gypsum used as a cement retarder.

Lime.—Related largely to the termination of the copper strike, marketed quicklime (calcium oxide) and hydrated lime (calcium hydroxide) increased 40 percent in quantity and 45 percent in value. Of the seven plants reporting production, three were at copper concentrators—Morenci, Ray, and San Manuel. Most of the lime was used in concentrating copper; the remainder was used in sugar refining, in open hearth furnaces, in manufacturing paper and pulp, and for miscellaneous uses.

Most of the lime was used within the State; a small quantity was shipped to consumers in California, New Mexico, Texas, and Mexico. Captive markets absorbed 43 percent. Approximately 517,000 tons of limestone was used in producing lime. Natural gas was used as a fuel for seven rotary and five shaft kilns in the State; fuel oil was used for one rotary; and coke was used in one shaft kiln.

Mica.—Scrap mica produced by Buckeye Mica Co. at its mine near Buckeye in Maricopa County was dry ground at the company mill in Buckeye. The ground material was sold for use in manufacturing roofing and paper materials.

Perlite.—Crude perlite produced at two mines in Pinal County was shipped to the Supreme Perlite, Inc., expanding plant at Phoenix, Maricopa County, and to expanding plants outside the State. Expanded perlite produced by Supreme Perlite, Inc., was sold for use as a concrete aggregate and in plaster, for loose-fill insulation, and as a soil conditioner. Harborlite Corp. shipped crude perlite from its mine in Pinal County to company-owned and other expanding plants outside the State.

Pumice.—Combined output of crude and prepared pumice and pumiceous materials declined 4 percent and 2 percent, respectively. The overall decline in production was attributed to a smaller tonnage of volcanic cinder used in road construction and maintenance by Federal, State, and county agencies, and the smaller quantity used as railroad ballast. Crude sales represented 61 percent of the total output; 39 percent was crushed and screened before shipment.

Pyrites.—Output of pyrite was 24 percent in quantity and 23 percent in value over that reported for the previous year. The major portion of the pyrite concentrate, recovered as a byproduct at the Magma Copper Co. Magma mill, was sold to Ray Mines as supplemental feed for its sulfuric acid plant. Primary feed for the acid plant was sulfur dioxide from the smelting of Ray concentrates. The sulfuric acid was used in leaching waste dumps and the sponge iron residue from the pyrites was used in the LPF process. A new facility to produce 750 tons daily of sulfuric acid from sulfur dioxide gas went on stream at Ray late in 1968.

Sand and Gravel.—Production of sand and gravel, sold or used, declined 4.5 million tons (24 percent) in quantity and $4.0 million (22 percent) in value. Output was reported from 76 commercial and 86 Government-crew and contractor operations. Of the 9.3 million tons shipped commercially, 97 percent was by truck, 1 percent by rail, and 2 percent by other means. Ninety-five percent of the total output was processed at 100 processing plants—55 stationary and 45 portable.

Commercial production consisted of 4.3 million tons of sand and 5.0 million tons of gravel. Approximately 43,000 tons of commercial sand and gravel was pit-run material. The average value received for pit-run material was $0.67 per ton; that for processed material, $1.07. The overall average for the 9.3 million tons of commercial sand and gravel produced was $1.07 per ton, $0.06 below that of the previous year.

Government-crew and contractor output consisted of 1.1 million tons of sand and 3.6 million tons of gravel; approximately 4.0 million tons (85 percent) was processed material. The average value received for processed material was $1.05; that for unprocessed material, $0.45.

Table 12.—Sand and gravel production in 1968, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Apache	256	$377
Cochise	529	476
Coconino	1,302	1,429
Gila	80	135
Graham	64	78
Greenlee	73	87
Maricopa	7,328	6,718
Mohave	548	368
Navajo	419	471
Pima	2,239	2,979
Pinal	502	560
Santa Cruz	41	69
Yavapai	258	276
Yuma	342	400
Total	13,981	14,423

Road construction absorbed 5.6 million tons (40 percent) of the total output of 13.9 million tons of construction sand and gravel; that for buildings was 6.2 million tons (44 percent) of the total; and 2.0 million tons was used as fill. A small quantity was sold or used for railroad ballast and other unspecified uses.

Although industrial sand production was at approximately the same level as that of the previous year, the value was slightly higher at $11.93 per ton, compared with $10.40 received in 1967. All of the industrial sand was used unground in oil-formation fracturing and as blast and engine sand.

Sand and gravel, produced in all 14 counties, ranged from 41,000 tons in Santa Cruz to 7.3 million tons in Maricopa County. Production in excess of 1 million tons was reported in Coconino, Maricopa, and Pima Counties.

Of the 76 sand and gravel operations classified as commercial, three produced over 1 million tons each; one produced between 500,000 and 1 million tons; 14 produced between 100,000 and 500,000 tons each; and 58 produced less than 100,000 tons each.

Stone.—The tonnage of stone produced in the State increased 72 percent, largely because of the increased demand for crushed limestone used as a concrete aggregate and in manufacturing lime and cement. Decreased output was reported for crushed basalt, marble, and granite. Crushed quartzite for use as a flux in the smelting of copper ores increased 67 percent.

Vermiculite.—At its mill in Phoenix, Ari-Zonolite Co. exfoliated vermiculite concentrates received from out of State. A small quantity of crude vermiculite was exfoliated in place by Solomon's Mines, Inc., near Buckeye.

Zeolite.—Mining and Metals Division, Union Carbide Corp., at its E–Z claims in Graham County produced zeolite which was used for experimental purposes.

MINERAL FUELS

Helium.[9]—Two new helium extraction plants began operations in Arizona in 1968, bringing the number of helium extraction

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[9] Prepared by Office of Assistant Director—Helium, Washington, D.C.

Table 13.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	2,663	$2,997	2,917	$3,164
Paving	560	665	604	586
Railroad ballast	[1] 102	[1] 287	[1] 124	[1] 330
Fill	455	175	630	182
Other	(1)	(1)	(1)	(1)
Industrial:				
Blast	(1)	(1)	(1)	(1)
Engine	1	9	(2)	12
Oil (hydrafrac)	(1)	(1)	(1)	(1)
Total	3,781	4,133	4,275	4,274
Gravel:				
Construction:				
Building	1,775	2,569	2,269	2,951
Paving	1,892	2,075	1,510	1,888
Railroad ballast	[3] 17	[3] 34	[4] 39	[4] 70
Fill	737	421	1,174	707
Other	(3)	(3)	(4)	(4)
Miscellaneous	30	49	(4)	(4)
Total	4,451	5,148	4,992	5,616
Total sand and gravel	8,232	9,281	9,267	9,890
Government-and-contractor operations:				
Sand:				
Building	--------	--------	401	401
Paving	[r] 1,589	[r] 1,497	620	595
Fill	355	283	70	68
Total	1,944	1,780	1,091	1,064
Gravel:				
Building	--------	--------	600	601
Paving	[r] 8,204	[r] 7,286	2,908	2,756
Fill	83	62	115	112
Total	[r] 8,287	[r] 7,348	3,623	3,469
Total sand and gravel	[r] 10,231	[r] 9,128	4,714	4,533
All operations:				
Sand	[r] 5,725	[r] 5,913	5,366	5,338
Gravel	[r] 12,738	[r] 12,496	8,615	9,085
Total	[r] 18,463	[r] 18,409	13,981	14,423

[r] Revised.

[1] Railroad ballast, "Other (construction)," blast, and oil (hydrafrac) sand combined to avoid disclosing individual company confidential data.

[2] Less than ½ unit.

[3] Railroad ballast, and "Other (construction)," gravel combined to avoid disclosing individual company confidential data.

[4] Railroad ballast, "Other (construction)," and miscellaneous gravel combined to avoid disclosing individual company confidential data.

plants in the State to three. The two new plants are Arizona Helium Corp.'s plant at Navajo and Air Reduction Co.'s plant at Teec Nos Pos. The Kerr-McGee Corp. plant at Navajo was the first helium extraction plant in Arizona.

Total helium production from the three plants in 1968 was 64.8 million cubic feet, with a value of $1.6 million. This compares with 1967 production of 73.8 million cubic feet valued at $2.1 million. Some of the helium from the plant at Teec Nos Pos is produced as crude helium, and shipped to Shiprock, N. Mex., for purification at a company-operated plant there. The Arizona Helium Corp. plant experienced some initial operating difficulties, but should produce Grade-A helium when normal production operations are begun. Kerr-McGee Corp. produces helium

Table 14.—Stone production in 1968, by counties

County	Short tons	Value
Apache	1,930	$3,378
Cochise	449,835	1,151,267
Coconino	W	W
Gila	145,617	283,420
Graham	1,570	2,748
Greenlee	W	W
Maricopa	10,769	21,369
Mohave	W	W
Navajo	4,056	16,224
Pima	W	W
Pinal	98,995	270,750
Santa Cruz	1,570	2,748
Yavapai	W	W
Yuma	12,096	107,167
Undistributed	2,566,559	4,380,069
Total	3,292,997	6,239,140

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

of Grade-A quality, and its plant is equipped to liquefy large quantities of this helium. No data are available on the relative volumes of gaseous and liquid helium produced at the plant.

Natural Gas.—Again, production of natural gas declined 16 percent.[10] Most of the output was used for field fuel or was flared.

El Paso Natural Gas Co. and Transwestern Pipeline Co. continued to supply natural gas to markets in southern California. In December, El Paso was building 135 miles of 30-inch pipeline and 39 miles of 6-inch line in Arizona and was seeking approval from The Federal Power Commission (FPC) for 27 miles of 30-inch line. Transwestern was waiting FPC approval for 298 miles of 30-inch and 7 miles of 36-inch line in Arizona, Texas, and New Mexico.

Petroleum.—Crude oil production increased 15.3 percent because of the first full year of production from the new Dineh bi Keyah field. The field limits apparently are defined, and at yearend 16 wells were producing. Output in 1968 was 3,279,579 barrels of oil; cumulative production in the field to the end of 1968 was 6,117,669 barrels, 88.3 percent of all oil produced in Arizona up to that time.

Second ranked field in the State was East Boundary Butte, with 36,857 barrels, 6 percent less than in 1967. Ranked third, Dry Mesa field, with output of 33,355 barrels dropped from 45,854 barrels, a 27-percent decline.

Overall drilling activity was six wells below that of the previous year, a 12.8-percent decline. The decrease resulted from lack of development drilling: nine wells were drilled, compared with 22 in 1967. One of the nine was a gas well; five were oil wells. Exploratory drilling rose from 25 to 32 wells, a 28-percent increase. One well, credited as an oil discovery, probably was not economically successful. The Champlin Petroleum Co., Navajo 335 No. 1, sec 4, T 41 N, R 29 E, Apache County, was completed for a daily flow gage of 8 barrels of oil and 8 barrels of water from the Akah zone (Pennsylvanian). The State did not report production from the well during the year.

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[10] State of Arizona Oil and Gas Conservation Commission. Monthly Oil, Gas, and Helium Production. December 1967 and December 1968.

Table 15.—Stone sold or used by producers, by kinds[1]

(Thousand short tons and thousand dollars)

Kind of stone	1964		1965		1966		1967		1968	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Granite	W	W	237	$362	-----	-----	35	$117	18	$24
Limestone	1,801	$2,484	1,602	2,147	1,590	$2,262	1,449	1,934	2,761	4,663
Marble	[2] 22	[2] 276	W	W	21	279	23	290	([3] [4])	[4] 11
Quartz, quartzite, and sandstone	788	1,675	460	1,234	318	884	211	705	351	1,043
Quartz and quartzite	NA	NA	NA	NA	NA	NA	NA	NA	344	930
Sandstone	NA	NA	NA	NA	NA	NA	NA	NA	7	113
Traprock	41	36	W	W	10	31	146	368	W	W
Other stone	1,107	1,812	175	429	330	636	46	77	163	499
Total	3,759	6,283	2,474	4,171	2,271	4,091	1,910	3,491	3,293	6,239

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Other stone."

[1] Data may not add to totals shown because of independent rounding.

[2] Excludes dimension marble; included with "Other stone."

[3] Less than ½ unit.

[4] Excludes crushed marble; included with "Other stone."

Table 16.—Stone sold or used by producers, by uses

	1967		1968	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction..........short tons..	132	$1,160	370	$2,008
Rubble..........do....	200	4,000	W	W
Other rough..........do....	----------	----------	1,046	10,458
Rough architectural..........cubic feet..	21,466	26,268	W	W
Dressed architectural..........do....	12,878	32,805	2,889	8,000
Flagging..........do....	29,225	42,924	1,640	2,230
Other dressed..........do....	----------	----------	56	7,500
Total (approximate, in short tons)......	5,200	107,157	8,000	131,767
Crushed and broken stone:				
Riprap..........short tons..	15,725	27,767	46,783	88,892
Metallurgical..........do....	305,289	682,937	503,190	1,155,944
Concrete and roadstone..........do....	248,603	610,618	(1)	(1)
Surface treatment aggregates..do....	NA	NA	29,990	57,900
Lime..........do....	347,504	702,095	495,680	1,268,826
Other..........do....	[2] 987,917	[2] 1,360,566	[3] 2,209,447	[3] 3,541,311
Total..........do....	1,905,038	3,383,983	3,285,040	6,107,373
Total stone (approximate, in short tons).	1,910,200	3,491,140	3,293,000	6,239,140

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Total."

[1] Concrete and roadstone subdivided in 1968. Concrete aggregate and dense graded roadbase withheld to avoid disclosing individual company confidential data; included with "Other."

[2] Includes stone used in abrasives, agriculture, animal feed, cement, landscaping, mineral food, paper, polyester filler, precasting, roofing granules, signs, stucco, terrazzo, walls, and for unspecified use.

[3] Includes stone used in abrasives, cement, concrete aggregate, dense graded roadbase, landscaping, poultry grit and mineral food, refractory stone, roofing aggregates, chips and granules, and terrazzo, and exposed aggregate.

Table 17.—Oil and gas well drilling in 1968, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Apache..........	1	---------	20	21	61,967
Cochise..........	---------	---------	1	1	---------
Coconino..........	---------	---------	2	2	10,197
Navajo..........	---------	---------	2	2	5,188
Yavapai..........	---------	---------	3	3	2,946
Yuma..........	---------	---------	3	3	5,575
Total..........	1	---------	31	32	85,873
Development completions:					
Apache..........	5	1	3	9	34,273
Total all drilling..........	6	1	34	41	120,146

Source: Petroleum Information Corp., 1968 Résumé, Oil and Gas Operations in the Rocky Mountain Region.

Table 18.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos: Jaquays Mining Corp..	1219 S. 19th Avenue Phoenix, Ariz. 85009	Underground mine and crushing, screening, and air-separation plant.	Gila.
Cement:			
American Cement Corp., Phoenix Division.	2404 Wilshire Blvd. Los Angeles, Calif. 90057	Dry-process, 3-rotary-kiln plant.	Yavapai.
Arizona Portland Cement Co., a division of California Portland Cement Co.	612 S. Flower Street Los Angeles, Calif. 90017	....do..........	Pima.
Clays:			
Arizona Gypsum Corp......	Box 6675 Phoenix, Ariz. 85005	Open-pit mine..........	Yavapai.
Filtrol Corp..........	3250 E. Washington Blvd. Los Angeles, Calif. 90023	....do..........	Apache.
McCarrell & Gurley..........	Box 1377 Gallup, N. Mex. 87301	....do..........	Do.
Tucson Pressed Brick Corp..	Box 2592 Tucson, Ariz. 85702	....do..........	Pima.

Table 18.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Copper:			
American Smelting and Refining Co.	120 Broadway New York, N.Y. 10005	3 open-pit mines, 2 mills, leach dumps, and precipitation plant.	Pima
Bagdad Copper Corp	Box 245 Bagdad, Ariz. 86321	Open-pit mine, mill, leach dumps, precipitation plant, and copper powder refinery.	Yavapai.
Duval Corp	Box 1271 Kingman, Ariz. 86401	Open-pit mine, mill, leach dumps, and precipitation plant.	Mohave.
	Box 38 Sahuarita, Ariz. 85629	do	Pima.
Inspiration Consolidated Copper Co.	Inspiration, Ariz. 85537	3 open-pit mines, 2 mills, leach dumps and in-place leaching, precipitation plant, rod plant rolling mill, electrolytic refinery.	Gila.
		Custom smelter	Do.
Kennecott Copper Corp., Ray Mines Division.	Hayden, Ariz. 85235	Open-pit mine, leach dumps and in-place leaching, precipitation plant.	Pinal.
		Mill and smelter	Gila.
Magma Copper Co.,			
San Manuel Division	Box M San Manuel, Ariz. 85631	Underground mine, mill, and smelter.	Pinal.
Superior Division	Box 37 Superior, Ariz. 85273	Underground mine, mill, and custom smelter.	Do.
Phelps Dodge Corp.,			
Copper Queen Branch	Drawer K Bisbee, Ariz. 85603	Open-pit mine, underground mine, mill, leach dumps and in-place leaching, and precipitation plant.	Cochise.
	Douglas, Ariz. 85607	Custom smelter	Do.
Morenci Branch	Morenci, Ariz. 85540	Open-pit mine, mill, leach dumps, precipitation plant, and smelter.	Greenlee.
New Cornelia Branch	Drawer 9 Ajo, Ariz. 85321	Open-pit mine, mill, and smelter.	Pima.
Pima Mining Co	Box 7187 Tucson, Ariz. 85713	Open-pit mine and mill	Do.
Tennessee Corp., Miami Copper Co. Division.	Box 100 Miami, Ariz. 85539	Open-pit mine, mill, leach dumps and in-place leaching, and 3 precipitation plants.	Gila.
Diatomite: Arizona Gypsum Corp.	Box 6675 Phoenix, Ariz. 85005	Open-pit mine and plant	Pinal.
Feldspar: International Minerals & Chemical Corp., Industrial Minerals Division.	Administration Center Old Orchard Road Skokie, Ill. 60079	do	Mohave.
Gold:			
Inspiration Consolidated Copper Co.	Inspiration, Ariz. 85537	*See* Copper	Gila.
Magma Copper Co.,			
San Manuel Division	Box M San Manuel, Ariz. 85631	do	Pinal.
Superior Divison	Box 37 Superior, Ariz. 85273	do	Do.
Phelps Dodge Corp.,			
Copper Queen Branch	Drawer K Bisbee, Ariz. 85603	do	Cochise.
Morenci Branch	Morenci, Ariz. 85540	do	Greenlee.
New Cornelia Branch	Drawer 9 Ajo, Ariz. 85321	do	Pima.
Shattuck Denn Mining Corp. (McFarland & Hullinger, lessee).	Drawer C Humboldt, Ariz. 86329	*See* Zinc	Yavapai.
Gypsum:			
Arizona Gypsum Corp.,			
Verde Division	Box 6675 Phoenix, Ariz. 85005	Open-pit mine and plant	Do.
Winkelman Division	do	do	Pinal.
National Gypsum Co	325 Delaware Avenue Buffalo, N.Y. 14202	do	Do.
Helium:			
Kerr-McGee Corp., Gas Processing Department.	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	4 wells and plant; Pinta Dome field.	Apache.
Eastern Petroleum Co	Box 291 Carmi, Ill. 62821	2 wells; Navajo Springs field.	Do.
Texaco Inc	1570 Grant Street Denver, Colo. 80203	Well, undesignated field.	Do.

Table 18.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Iron ore: CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	Open-pit mine	Navajo.
Lead: Shattuck Denn Mining Corp. (McFarland & Hullinger, lessee).	Drawer C Humboldt, Ariz. 86329	*See* Zinc	Yavapai.
Lime:			
Paul Lime Plant, Inc	Drawer T Douglas, Ariz. 85607	5-rotary-kiln plant	Cochise.
Phelps Dodge Corp., Morenci Branch.	Morenci, Ariz. 85540	1 rotary-kiln, 1 fluidized-bed-kiln plant.	Greenlee.
Mercury:			
Phoenix Sunflower Industries, Inc.	220 W. 3d Street Scottsdale, Ariz. 85251	Open-pit mine, crusher, and furnace.	Maricopa.
Posey Mining Co	Box 590 Mesa, Ariz. 85201	do	Do.
Mica: Buckeye Mica Co	Box 416 Buckeye, Ariz. 85326	Open-pit mine, stationary crushing and screening plant, dry grinding mill.	Do.
Molybdenum:			
American Smelting and Refining Co.	120 Broadway New York, N.Y. 10005	*See* Copper	Pima.
Bagdad Copper Corp	Box 245 Bagdad, Ariz. 86321	do	Yavapai.
Duval Corp	Box 1271 Kingman, Ariz. 86401	do	Mohave.
	Box 38 Sahuarita, Ariz. 85629	do	Pima.
Magma Copper Co., San Manuel Division.	Box M San Manuel, Ariz. 85631	do	Pinal.
Pima Mining Co	Box 7187 Tucson, Ariz. 85713	do	Pima.
Natural gas and petroleum:			
Consolidated Oil & Gas, Inc	4150 E. Mexico Avenue Denver, Colo. 80222	Natural gas wells; East Boundary Butte field.	Apache.
El Paso Natural Gas Co	Box 1492 El Paso, Tex. 79948	Natural gas wells; Bita Peak field.	Do.
Humble Oil & Refinery Co	2000 Classen Center North Bldg. Oklahoma City, Okla. 73106	Crude oil wells; East Boundary Butte field.	Do.
Kerr-McGee Corp	Kerr-McGee Bldg. Oklahoma City, Okla. 73106	Crude oil and natural gas wells; Dineh bi Keyah field.	Do.
Monsanto Co., Hydrocarbons Polymers Division.	800 N. Lindbergh Blvd. St. Louis, Mo. 63116	Crude oil wells; Dry Mesa field.	Do.
Pan American Petroleum Corp.	Box 591 Tulsa, Okla. 74101	Crude oil wells.	Do.
Texaco Inc	1570 Grant Street Denver, Colo. 80203	Crude oil wells; Walker Creek field.	Do.
Perlite:			
Arizona Perlite Roofs, Inc	1012 S. 20th Place Phoenix, Ariz. 85034	Open-pit mine	Pinal.
Harborlite Corp	Box 458 Escondido, Calif. 92025	do	Do.
Pumice:			
Apache County Highway Dept.	St. Johns, Ariz. 85936	do	Apache.
Atchison, Topeka & Santa Fe Railway Co.	Winslow, Ariz. 86047	Open-pit mine and plant	Coconino.
Peter Kiewit Sons' Co	Box 1055 Glendale, Ariz. 85301	Open-pit mine	Do.
Superlite Bldrs. Supply, Inc	5201 N. 7th Street Phoenix, Ariz. 85014	do	Do.
Pyrites: Magma Copper Co., Superior Division.	Box 37 Superior, Ariz. 85273	*See* Copper	Pinal.
Sand and gravel (commercial):			
Arizona Sand & Rock Co	Box 20067 Phoenix, Ariz. 85036	2 pits and plants	Maricopa.
Tucson Sand & Soil, Inc	2430 W. Curtis Street Tucson, Ariz. 85705	Pit and plant	Pima.
Union Rock & Materials Corp.,			
Bentson Contracting Co. Division.	2800 S. Central Avenue Phoenix, Ariz. 85040	3 pits and plants	Maricopa.
San Xavier Rock & Materials Division.	do	2 pits and plants	Pima.
United Metro Materials & Concrete Co., Inc.	Box 13309 Phoenix, Ariz. 85002	4 pits and plants	Maricopa.
		2 pits and plants	Pinal.
		Pit and plant	Yuma.

Table 18.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Silver:			
American Smelting and Refining Co.	120 Braodway New York, N.Y. 10005	*See* Copper	Pima.
Bagdad Copper Corp	Box 245 Bagdad, Ariz. 86321	do	Yavapai.
Duval Corp	Box 1271 Kingman, Ariz. 86401	do	Mohave.
	Box 38 Sahuarita, Ariz. 85629	do	Pima.
Inspiration Consolidated Copper Co.	Inspiration, Ariz. 85537	do	Gila.
Kennecott Copper Corp., Ray Mines Division.	Hayden, Ariz. 85235	do	Pinal.
Magma Copper Co.,			
San Manuel Division	Box M San Manuel, Ariz. 85631	do	Do.
Superior Division	Box 37 Superior, Ariz. 85273	do	Do.
Phelps Dodge Corp.,			
Copper Queen Branch	Drawer K Bisbee, Ariz. 85603	do	Cochise
Morenci Branch	Morenci, Ariz. 85540	do	Greenlee.
New Cornelia Branch	Drawer 9 Ajo, Ariz. 85321	do	Pima.
Pima Mining Co	Box 7187 Tucson, Ariz. 85713	do	Do.
Shattuck Denn Mining Corp. (McFarland & Hullinger, lessee).	Drawer C Humboldt, Ariz. 86329	*See* Zinc	Yavapai.
Tennessee Corp., Miami Copper Co. Division.	Box 100 Miami, Ariz. 85539	*See* Copper	Gila.
Stone:			
American Cement Corp., Phoenix Division.	2404 Wilshire Blvd. Los Angeles, Calif. 90057	Quarry and plant	Yavapai.
Arizona Portland Cement Co., a division of California Portland Cement Co.	612 S. Flower Street Los Angeles, Calif. 90017	do	Pima.
Peter Kiewit Sons' Co	Box 1055 Glendale, Ariz. 85301	do 8 quarries and 2 plants	Apache. Coconino.
Uranium:			
Cotter Corp	Box 751 Canon City, Colo. 81212	Underground mine	Do.
Foote Mineral Co	Box 757 Shiprock, N. Mex. 87420	Underground mine and dump.	Apache.
Vanadium: Foote Mineral Co	do	*See* Uranium	Do.
Zinc:			
Cyprus Mines Corp., Old Dick Mining and Timber Co., Old Dick Division.	Box 457 Bagdad, Ariz. 86321	Underground mine and mill.	Yavapai.
Shattuck Denn Mining Corp. (McFarland & Hullinger, lessee).	Drawer C Humboldt, Ariz. 86329	do	Do.

The Mineral Industry of Arkansas

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Arkansas Geological Commission, Norman F. Williams, Director and State Geologist, Little Rock, Ark., for collecting information on all minerals except fuels.

By William G. Park [1] and W. D. Dietzman [2]

Mineral production attained a record high value of $198.7 million, an increase of 10.7 percent over that of 1967 and 4.5 percent over the previous high attained in 1966. The top five mineral commodities in order of value were petroleum, natural gas, bauxite, stone, and bromine. Nonmetals mineral value exceeded mineral fuels value during 1968. A $3.3 million net gain in value of mineral fuels over 1967 resulted from the increase in production and value of natural gas and related liquids and coal, although production and value of petroleum decreased. Bauxite value registered a 26.2-percent gain over 1967 value and vanadium oxide was produced for the first time. No mercury production was reported in 1968. Other gains in mineral value were from barite, bromine, clays, lime, abrasive stone, and tripoli.

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[1] Physical scientist, Bureau of Mines, Dallas, Tex.

[2] Petroleum engineer, Bureau of Mines, Dallas, Tex.

Table 1.—Mineral production in Arkansas [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite short tons	229,344	[2] $2,266	166,183	[3] $3,839
Bauxite thousand long tons, dried equivalent	1,571	18,269	1,582	23,058
Bromine thousand pounds	64,450	14,885	95,499	20,790
Clays thousand short tons	941	1,740	919	2,134
Coal (bituminous) do	189	1,427	211	1,576
Gem stones	NA	35	NA	30
Lime thousand short tons	187	2,723	206	3,058
Natural gas million cubic feet	116,522	17,828	156,627	24,456
Natural gas liquids:				
Natural gasoline and cycle products thousand 42-gallon barrels	656	1,780	753	2,192
LP gases do	1,279	3,009	1,435	2,899
Petroleum (crude) do	21,075	56,902	19,464	53,137
Sand and gravel thousand short tons	14,239	15,531	12,997	14,648
Stone (includes shell (1967) and slate) do	17,454	23,236	16,322	22,256
Value of items that cannot be disclosed: Abrasive stone, cement, gypsum, mercury (1967), soapstone, tripoli, and vanadium (1968)	XX	19,822	XX	24,655
Total	XX	179,453	XX	198,723
Total 1957–59 constant dollars	XX	r 176,248	XX	p 197,575

r Revised. p Preliminary. NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Crude ore value.

[3] Processed product value.

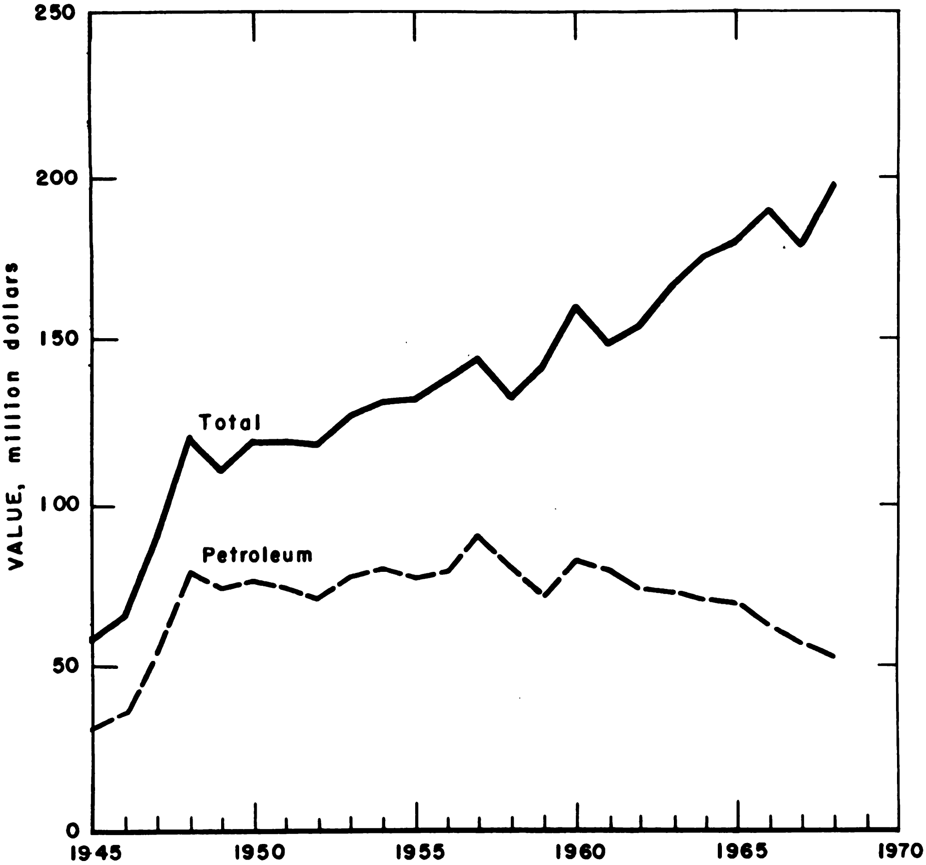

Figure 1.—Value of petroleum and total value of mineral production in Arkansas.

Table 2.—Value of mineral production in Arkansas, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Arkansas	$52	$3	Sand and gravel.
Ashley	175	403	Sand and gravel, lime.
Baxter	78	199	Sand and gravel, stone.
Benton	312	W	Stone, sand and gravel.
Boone	483	305	Do.
Bradley	713	444	Petroleum, sand and gravel.
Calhoun	1,194	933	Sand and gravel, petroleum.
Carroll	W	W	Sand and gravel.
Chicot	100	1	Do.
Clark	389	278	Stone, sand and gravel, clays.
Clay	124	146	Sand and gravel.
Cleburne	82	101	Stone.
Cleveland	46	28	Sand and gravel.
Columbia	26,922	29,607	Petroleum, bromine, natural gas liquids, natural gas, sand and gravel.
Conway	909	2,000	Stone, sand and gravel, natural gas.
Craighead	329	314	Sand and gravel, clays.
Crawford	3,842	4,763	Natural gas, stone, sand and gravel.
Crittenden	99	W	Clays, sand and gravel.

See footnote at end of table.

Table 2.—Value of mineral production in Arkansas, by counties—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Cross	$1,313	$1,205	Sand and gravel.
Dallas	15	61	Do.
Desha	354	1	Do.
Drew	148	132	Do.
Faulkner	1,052	956	Stone, sand and gravel.
Franklin	5,861	8,356	Natural gas, stone, coal, sand and gravel.
Fulton	40	50	Sand and gravel, stone.
Garland	469	W	Vanadium, abrasive stone, stone, tripoli, sand and gravel, gem stones.
Grant	151	89	Sand and gravel.
Greene	354	261	Do.
Hempstead	249	147	Sand and gravel, clays, petroleum.
Hot Spring	3,782	4,841	Barite, clays, sand and gravel, stone.
Howard	5,913	5,926	Cement, gypsum, stone, clays, slate, sand and gravel.
Independence	2,410	3,017	Stone, lime, sand and gravel.
Izard	2,031	W	Stone, sand and gravel.
Jackson	130	207	Sand and gravel.
Jefferson	535	505	Lime, sand and gravel.
Johnson	2,396	3,285	Natural gas, coal, stone, clays, sand and gravel.
Lafayette	15,474	14,189	Petroleum, natural gas, natural gas liquids, sand and gravel.
Lawrence	865	W	Stone, sand and gravel.
Lee	6	12	Sand and gravel.
Lincoln	132	73	Do.
Little River	W	W	Cement, stone, clays, sand and gravel.
Logan	1,356	1,598	Natural gas, stone, sand and gravel.
Lonoke	386	W	Clays, sand and gravel.
Madison	7	46	Sand and gravel.
Marion	129	110	Sand and gravel, stone.
Miller	5,777	6,454	Petroleum, sand and gravel, natural gas, clays.
Mississippi	71	94	Sand and gravel.
Monroe	95	2	Do.
Montgomery	W	W	Slate, sand and gravel.
Nevada	2,187	2,241	Petroleum, sand and gravel.
Newton	97	57	Stone, sand and gravel.
Ouachita	8,058	8,460	Petroleum, sand and gravel, natural gas, clays.
Perry	151	W	Stone.
Phillips	W	8	Sand and gravel.
Pike	1,052	771	Sand and gravel, gypsum, gem stones, stone.
Poinsett	208	W	Sand and gravel.
Polk	203	139	Tripoli, clays, sand and gravel, stone.
Pope	1,490	1,375	Natural gas, stone, sand and gravel, clays.
Prairie	113	234	Sand and gravel.
Pulaski	9,131	9,064	Stone, sand and gravel, clays.
Randolph	163	30	Stone, sand and gravel.
St. Francis	W	W	Sand and gravel.
Saline	21,120	25,674	Bauxite, lime, sand and gravel, clays, slate, soapstone, stone.
Scott	119	406	Natural gas, stone, sand and gravel.
Searcy	86	14	Sand and gravel.
Sebastian	2,979	3,941	Natural gas, stone, sand and gravel, clays, coal.
Sevier	W	W	Sand and gravel.
Sharp	172	18	Sand and gravel, stone.
Stone	64	122	Stone, sand and gravel.
Union	25,548	27,206	Bromine, petroleum, natural gas, sand and gravel, clays.
Van Buren	75	W	Stone.
Washington	546	502	Stone, natural gas, sand and gravel.
White	627	W	Stone, sand and gravel.
Woodruff	330	7	Sand and gravel.
Yell	354	289	Sand and gravel, stone.
Undistributed	17,235	27,023	
Total	179,453	198,723	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Table 3.—Indicators of Arkansas business activity

	1967	1968[p]	Change (percent)
Employment and labor force, annual average:			
Total labor force.......thousands	691.4	705.0	+2.0
Unemployment.......do	32.5	31.0	−4.6
Employment:			
Food and kindred products.......do	23.7	23.6	−.4
Lumber and wood products.......do	23.5	21.6	−8.1
Chemicals and allied products.......do	5.8	6.1	+5.2
Petroleum refining and related industries.......do	1.9	1.9	.0
Stone, clay, and glass products.......do	4.0	4.2	+5.0
Primary metal industries.......do	4.0	4.5	+12.5
Mining.......do	4.8	4.8	.0
Contract construction.......do	31.9	30.5	−4.4
All industries.......do	658.9	674.0	+2.3
Factory payrolls.......millions	$648.9	$727.2	+12.1
Personal income:			
Total.......do	$4,130.0	$4,576.0	+10.8
Per capita	$2,095.0	$2,304.0	+10.0
Construction activity:			
Building permits, total private nonresidential.......millions	$52.9	$45.0	−14.9
Construction contracts.......do	$524.5	$397.0	−24.3
Cement shipments to and within Arkansas thousand 376-pound barrels	4,436.0	4,436.8	.0
Farm marketing receipts.......millions	$851.3	$954.6	+12.1
Mineral production.......do	$179.5	$198.7	+10.7

[p] Preliminary.

Sources: Survey of Current Business, U.S. Department of Commerce; Bureau of Business and Economic Research, University of Arkansas; State Employment Security Division, Department of Labor, Arkansas' Farm Income Situation, U.S. Department of Agriculture.

Arkansas was one of the foremost producers of bromine. Four plants extracted over 95 million pounds of bromine from brine produced from the Smackover Formation.

Production of vanadium oxide began at the Union Carbide Corp. extraction plant, Garland County, in May.

The Walker Creek oilfield discovered by H. A. Chapman in Lafayette County, was the most significant find in recent years for south Arkansas. The W. E. Helms well 1, drilled 3 miles northeast of the Lake Erling field, penetrated about 288 feet of the Smackover Formation with effective net pay of 54 feet. By yearend, two additional wells had been completed. The Arkansas Oil and Gas Commission set an unprecedented 320-acre spacing order for the field and special allowable of 320 barrels per day was granted each well.

Interest in Arkansas coal deposits was increased because of proximity to planned navigational facilities along the upper Arkansas River and the low sulfur content of the coal.

The Arkansas Geological Commission began a corehole and sampling study to determine cinnabar resources in Pike County. The Commission entered into a cooperative agreement with the U.S. Geological Survey (USGS) for compilation of geological and topographic maps of the State with completion scheduled for 1973.

Construction of the Southwest Experimental Fast Oxide Reactor (SEFOR) plant in Washington County was completed during the year. Experiments to develop nuclear powerplants that will produce fuel for self-sustained operation and generation of electricity were begun. Arkansas Power and Light Co. (AP&L) began constructing a nuclear-fueled 800,000-kilowatt generating plant near Russellville. Commercial operation is scheduled by 1973. AP&L planned to construct a steam turbine, 500,000-kilowatt generating plant at Lake Catherine. Water from the lake will be used to cool the steam-generating facilities. The Federal Power Commission (FPC) established standards for thermal quality of water at the operation.

The U.S. Army Corps of Engineers continued construction of locks and dams on the Arkansas River including Dardanelle Reservoir. Navigational facilities on the lower Arkansas River and Locks and Dams 1 through 6 were complete at yearend. Arkansas River Development Program construction provided a major market for stone, sand and gravel, and cement produced in the State; however, with construction nearing completion this market was reduced. Construction materials used for roadbuilding purposes continued about the same during the year.

Employment.—Total personal income was $4,576 million, a 10.8 percent increase over that of 1967. Annual personal earnings increased 2.3 percent in mining and 1.6 percent in contract construction. Total labor force during 1968 was 705,000 with an unemployment rate of 4.4 percent. Average monthly employment in the mining industry remained virtually unchanged.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	110	170	19	149	-------	5	33.55	382
Metal	2,048	275	563	4,500	-------	51	11.33	251
Nonmetal	1,029	251	259	2,073	-------	59	28.46	507
Sand and gravel	776	251	195	1,804	-------	34	18.85	253
Stone	1,345	272	366	3,157	-------	79	25.02	2,638
Total [1]	5,308	264	1,401	11,683	-------	228	19.51	944
1968:p								
Coal	125	166	21	168	-------	6	35.66	392
Metal	1,935	285	551	4,413	-------	68	15.41	1,924
Nonmetal	1,060	247	263	2,101	-------	68	32.37	605
Sand and gravel	630	251	158	1,425	-------	27	18.95	348
Stone	1,260	276	347	2,975	1	51	17.48	3,358
Total	5,010	267	1,340	11,082	1	220	19.94	1,833

p Preliminary.
[1] Data does not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Value of mineral fuels was $84.3 million, 42.4 percent of the total mineral production value. Value of coal, natural gas, and natural gasoline and cycle products increased in 1968 while value of LP gases and petroleum decreased. Mineral fuels lost the lead as the principal contributor to the State's total mineral value. Petroleum was the most important single mineral commodity although production and value decreased for the eighth consecutive year.

Carbon Black.—Carbon black output from Columbian Carbon Co.'s El Dorado plant continued for the 17th consecutive year. Quantity and value decreased over 20 percent as compared with 1967 data. Feedstock was hydrocarbon liquids and natural gas.

Coal (Bituminous).—Eight coal mines (six strip and two underground) produced 1,000 or more tons each. These mines accounted for increases of 11.6 percent in coal production and 10.4 percent in value. Of the 211,000 tons total coal output, 72 percent was from strip mines. Output from the five mines in Johnson County accounted for 66.4 percent of the State's total; remaining coal production came from Franklin and Sebastian Counties. Coal leasing activity increased during the year, as Oklahoma National Gas Co. announced

Table 5.—Coal (bituminous) production [1]

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	212	$1,508
1965	226	1,643
1966	236	1,640
1967	189	1,427
1968	211	1,576

[1] Data from mines producing 1,000 tons or more.

plans to evaluate coal reserves on a 5,500-acre tract in Johnson County.

Natural Gas.—Production of natural gas increased for the 12th consecutive year gaining 34 percent over 1967 output while value increased 37 percent. Natural gas ranked second in mineral value for the year. North Arkansas gasfields supplied over 70 percent of the total gas produced in the State. Production from north Arkansas was predominantly from Pennsylvanian age sediments; other production was from Silurian, Devonian, and Ordovician sediments. Production from south Arkansas was from Upper and Lower Cretaceous and Jurassic sediments. Reserves declined 3.4 percent according to the American Gas Association, Inc., and reversed the trend from previous years.

Table 6.—Gross withdrawals and disposition of natural gas

(Million cubic feet)

Year	Gross withdrawals [1]			Disposition			Vented and wasted [3]
				Marketed production [2]		Repressuring	
	From gas wells	From oil wells	Total	Quantity	Value (thousands)		
1964	57,900	42,900	100,800	75,753	$11,806	21,411	3,636
1965	57,500	46,500	104,000	82,831	12,922	20,155	1,014
1966	63,100	58,479	121,579	105,174	16,407	15,196	1,209
1967	81,491	46,038	127,529	116,522	17,828	10,010	997
1968	110,898	51,257	162,155	156,627	24,456	4,633	895

[1] Marketed production plus quantities used in repressuring, vented, and wasted.

[2] Comprises gas sold or consumed by producers, including losses in transmission, quantities added to storage, and increases in gas in pipelines.

[3] Includes direct waste on producing properties and residue blown to air.

Pipeline Construction.—A 100-mile pipeline from Logan County, Ark., to McDonald County, Mo., started in 1967, was completed. The line transports about 100 million cubic feet per day of natural gas from Arkansas Louisiana Gas Co. (Arkla) reserves in eastern Oklahoma and western Arkansas to Cities Service Gas Co. pipeline system serving southwestern Missouri. Arkla completed a new 29-mile, 30-inch gas transmission line westward from Driggs, Ark. The new line looped the original 24-inch line nearly to the Oklahoma-Arkansas border and increased transmission capability from 375 to 530 million cubic feet daily.

Natural Gas Liquids.—Output of natural gas liquids increased 253,000 barrels or 13.1 percent over that of 1967; value increased 6.3 percent. At yearend, six plants were processing gas in four counties of south Arkansas. These plants have a total capacity of 432 million cubic feet per day. The Arkla Chemical Corp. Hamilton plant (processing gas from various fields), Columbia County, was the leader in natural gas liquids output. Reserves declined 10.1 percent according to the American Petroleum Institute (API).

Petroleum.—Output and value of petroleum declined for the eighth consecutive

Table 7.—Natural gas liquids production

(Thousand 42-gallon barrels and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	716	$1,678	1,467	$2,460	2,183	$4,138
1965	662	1,578	1,661	3,139	2,323	4,717
1966	763	1,923	1,540	3,233	2,303	5,156
1967	656	1,780	1,279	3,009	1,935	4,789
1968	753	2,192	1,435	2,899	2,188	5,091

year. Output declined 7.6 percent while value declined 6.6 percent, reflecting an increase in average unit price. Petroleum remained the most important mineral in the State and accounted for 26.7 percent of the total mineral value. The total State's production was from nine south Arkansas counties, and reserves declined 9.7 percent according to API. Six refineries operated in 1968 and had a combined processing capacity of 93,500 barrels per calendar day.

During 1968 there were 6,445 producing wells. Fifty-seven unitized secondary recovery and pressure maintenance operations accounted for 47 percent of the total production. Secondary recovery and pressure maintenance operations continued in Lafayette, Miller, Columbia, Union, Ouachita, and Nevada Counties. For the first time in the State, carbon dioxide (CO_2) was injected in a secondary recovery operation. U.S. Oil and Refining Co. began injecting CO_2 into the Baker sand, Ritchie field, Union County. Other recovery operations utilize water, gas, and steam injection, and insitu combustion.

Smackover field, with production over 3 million barrels of oil, was the leading producer in the State, replacing Magnolia which produced about 2.5 million barrels during the year. Third-ranked Stephens field was followed by Schuler and Wesson fields.

Table 8.—Crude petroleum production, indicated demand, and stocks in 1968, by months

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Arkansas
January	1,769	1,752	946
February	1,607	1,598	955
March	1,719	1,565	1,109
April	1,658	1,679	1,088
May	1,704	1,730	1,062
June	1,619	1,670	1,011
July	1,604	1,552	1,063
August	1,597	1,599	1,061
September	1,533	1,544	1,050
October	1,606	1,611	1,045
November	1,526	1,631	940
December	1,522	1,585	877
Total:			
1968	19,464	19,516	XX
1967	21,075	21,093	XX

XX Not applicable.

Petroleum and Natural Gas Exploration and Development.—Both exploratory and developmental drilling declined for the third consecutive year. Total drilling was 14.3 percent below 1967 figures. Overall success ratio was about 48 percent compared with 50 percent during 1967, but only 3.7 percent of the exploratory wells were completed as oil and gas producers. Two new gasfields were discovered in north Arkansas—Hagerville and Hunt fields in Johnson County; and two oilfields in south Arkansas—Walker Creek in Lafayette County and Lloyd Creek in Calhoun County. Developmental wells accounted for 10 new oil pools in south Arkansas and three new gas pools in north Arkansas. Oil completions decreased by 15.9 percent and gas completions decreased by 24.3 percent. Gas well success ratio was 54.0 percent as compared with 72 percent in 1967.

Oil well success ratio was 44.4 percent during 1968, up from 43 percent in 1967. Union County ranked first in number of successful oil well completions followed by Ouachita and Nevada Counties; the three accounted for 87 percent of the successful oil wells drilled. Oil discoveries were confined to Cretaceous and Jurassic sedimentary formations.

Of the two new fields and 10 new pools discovered in south Arkansas during 1968, Walker Creek field in Lafayette County was the most notable. The discovery well, drilled by H. A. Chapman, was completed to produce from the Smackover limestone at 10,870 to 10,930 feet. The Arkansas Oil and Gas Commission issued orders for 320-acre spacing in the new Walker Creek field, thus establishing new oilfield spacing for the State. The Commission also granted a special well allowable of 320 barrels per day.

First commercial Ordovician gas production in the State was established when Diamond Shamrock Corp. completed the Matre well 1 in the Arkoma Basin as a new gas pool discovery in the Hollis Lake field.

Petrochemicals.—Production during the year at plants such as Arkla Chemical Corp.'s Helena plant; Continental Oil Co.'s Blytheville plant; and Monsanto Co.'s El Dorado plant included ammonia, ammonium nitrate, diammonium phosphate, urea, anhydrous ammonia, and nitrogen fer-

Table 9.—Oil and gas drilling in 1968, by counties

County	Development			Exploratory			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Benton	-----	-----	1	-----	-----	-----	1
Bradley	2	-----	-----	-----	-----	-----	2
Calhoun	-----	-----	1	1	-----	1	3
Chicot	-----	-----	-----	-----	-----	2	2
Columbia	3	-----	4	-----	-----	8	15
Conway	-----	-----	-----	-----	-----	3	3
Crawford	-----	17	1	-----	-----	2	20
Drew	-----	-----	-----	-----	-----	2	2
Franklin	-----	15	6	-----	-----	1	22
Hempstead	-----	-----	1	-----	-----	-----	1
Jefferson	-----	-----	-----	-----	-----	2	2
Johnson	-----	4	3	-----	2	2	11
Lafayette	4	-----	17	1	-----	11	33
Little River	-----	-----	-----	-----	-----	3	3
Logan	-----	4	5	-----	-----	-----	9
Lonoke	-----	-----	-----	-----	-----	4	4
Miller	4	-----	7	-----	-----	8	19
Montgomery	-----	-----	-----	-----	-----	2	2
Nevada	9	-----	3	-----	-----	10	22
Ouachita	21	-----	2	-----	-----	9	32
Pope	-----	1	3	-----	-----	2	6
Scott	-----	3	1	-----	-----	-----	4
Sebastian	-----	8	4	-----	-----	1	13
Union	71	1	25	-----	-----	30	127
White	-----	-----	-----	-----	-----	1	1
Yell	-----	1	1	-----	-----	-----	2
Total:							
1968	114	54	85	2	2	104	361
1967	135	72	121	3	2	88	421

Source: Arkansas Oil and Gas Statistical Bulletin. V. 27, No. 12, December 1967 through v. 28, No. 3, March 1969.

Table 10.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves Dec. 31, 1967	Changes in proved reserves, due to revisions, extensions, and new discoveries in 1968	Proved reserves, Dec. 31, 1968 (production was deducted)	Change from 1967 (percent)
Crude oil ……… thousand barrels	176,429	2,288	159,283	−10
Natural gas liquids [1] ……… do	14,574	------------	13,096	−10
Natural gas ……… million cubic feet	2,811,251	60,329	2,715,065	−3

[1] Includes condensate, natural gasoline, and LP gases.

Source: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas. Published in the Tulsa Daily World, 64th yr., No. 206, Apr. 7, 1969, p. 10.

tilizers. Amoco Chemical Corp.'s plant at El Dorado produced viscous polypropene and polybutene.

NONMETALS

Total value of nonmetallic mineral commodities exceeded mineral fuels. The largest gain in value ($5.9 million) was registered by bromine. Value of clays, lime, abrasive stone, and tripoli increased by $849,000 while other nonmetallic minerals decreased by over $2 million.

Abrasive Stone.—Production of novaculite mined for whetstone manufacture was 1.1 percent below that in 1967, but value was 5.6 percent greater, reflecting an increase in unit price. Five operators in Garland County mined novaculite and Norton Co.'s production was shipped to Eastern States for finishing.

Barite.—Total barite production declined sharply in 1968, principally because of reduced oil and gas well drilling requirements. National Lead Co., Baroid Division, and Dresser Minerals mined and processed ore in Hot Spring County. Reported unit price for barite in 1967 was prior to processing and averaged $9.88 per ton. Unit price reported for barite in 1968 was after processing and averaged $23.10 per ton. The Milwhite Co., Inc., processed Missouri barite at its Bryant plant in Saline County, Ark. The State dropped to third in barite production in the United States.

Table 11.—Primary barite sold or used by producers

Year	Short tons	Value (thousands)
1964	233,455	$2,202
1965	249,233	2,379
1966	232,856	2,266
1967	229,344	2,266
1968	166,183	3,839

Bromine.—Four plants extracted bromine from brine found in the Smackover limestone of Jurassic age. Output and value increased 48 and 40 percent, respectively. Arkansas ranked third in production and second in value nationally. The Dow Chemical Co. plant, Columbia County, completed its first full year of operation and contributed significantly toward increased production. Originally, bromine was extracted from brine produced from oil wells. At yearend, most of the bromine was from brine wells drilled expressly to supply the bromine plants, and there were 20 supply and 14 disposal wells. Brine production averaged about 135,000 barrels per day.

Bromet Co., a newly formed partnership of Ethyl Corp. and Great Lakes Chemical Corp., began construction of a $7.5 million bromine extraction plant in Columbia County with completion scheduled for mid-1969. Plant processing capacity will be 150,000 barrels of brine per day. The plant will produce elemental bromine, ethylene dibromide, and as a pollution control measure, will recover elemental sulfur. By yearend, 14 brine supply and five disposal wells were completed.

Cement.—Cement shipments by two producers, including portland and masonry, increased 4 percent but value decreased slightly resulting from a reduction in unit price. Almost 70 percent of the cement was shipped to ready-mix concrete companies and highway contractors. Other cement consumers included building material dealers, concrete product manufacturers, and other contractors. Ninety percent of the total cement transported was in bulk form. Over 93 percent of the cement output was shipped by truck and rail with truck haulage accounting for the greater amount.

Clays.—Thirteen companies operated plants or mines in 17 counties, and the U.S. Forest Service produced clay for road construction in various counties. The four leading clay producing counties (Hot Spring, Lonoke, Johnson, and Pulaski) accounted for 60.9 percent of the total clay output. Total production decreased 2.3 percent, but value increased sharply due to higher average unit prices and a 50 percent increase in kaolin output. Kaolin clay was mined in Pulaski and Saline Counties by two companies for chemical and refractory uses. Fire clays were produced in Hot Spring and Miller Counties. Clay was used in cement manufacture by Arkansas Cement Corp. and Ideal Cement Co. Two lightweight aggregate plants were in operation at yearend utilizing clays from Lonoke and Crittenden Counties. Ten brick plants operated in eight counties. Acme Brick Co.'s Perla plant at Malvern increased capacity by about one-third with addition of a tunnel kiln, blending bins, and automated system of brick manufacture.

Gypsum.—Output and value of gypsum declined slightly from 1967. Gypsum was produced by Dierks Forests, Inc., in Howard County, and Dulin Bauxite Co., Inc., in Pike County. Both are conducting strip mining operations and land reclamation of mined-out areas. The gypsum was used in the manufacture of wallboard and related products, and of cement.

Lime.—Output and value of lime increased 10.2 and 12.3 percent, respectively. Production was reported from four counties: Saline, Independence, Jefferson, and Ashley. Five companies produced primary lime. Aluminum Company of America (Alcoa) and Reynolds Metals Co. produced lime at plants in Saline County, from limestone mined in Izard County, and used it in reducing bauxite to alumina. The principal producer of quicklime and hydrated lime was Rangaire Corp., Batesville White Lime Division and the limestone was mined and processed in Independence County. Three paper companies reported regeneration of lime during the year.

Sand and Gravel.—Output and value decreased for the second year by 8.7 and 5.7 percent, respectively. Lower production was due primarily to decreased construc-

Table 12.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	8,637	$10,990	3,157	$3,846	11,794	$14,836
1965	9,559	12,001	3,247	3,885	12,806	15,886
1966	11,677	15,656	4,379	5,382	16,056	21,038
1967	10,202	13,118	4,037	2,414	14,239	[1] 15,531
1968	10,682	12,795	2,315	1,848	12,997	14,643

[1] Data does not add to total value because of independent rounding.

Table 13.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,145	$1,190	1,144	$1,402
Paving	2,681	3,290	2,441	2,354
Other [1]	640	1,056	562	1,146
Total sand	4,466	5,536	4,147	4,902
Gravel:				
Building	1,431	2,217	1,263	2,087
Paving	4,214	5,275	5,135	5,685
Fill	21	12	130	105
Other [2]	70	73	7	16
Total gravel	5,736	7,577	6,535	7,893
Total sand and gravel	10,202	13,118	10,682	12,795
Government-and-contractor operations:				
Sand:				
Building	W	W	1	1
Paving	W	W	466	361
Total sand	1,397	765	467	362
Gravel:				
Building	--------	--------	2	2
Paving	2,640	1,653	1,650	1,386
Fill	--------	--------	196	98
Total gravel	2,640	1,653	1,848	1,486
Total sand and gravel	4,037	[3] 2,414	2,315	1,848
Grand total	14,239	[3] 15,531	12,997	14,643

W Withheld to avoid disclosing individual company confidential data.
[1] Includes fill, other construction sand, and industrial sand (ground and unground).
[2] Includes other construction gravel and miscellaneous gravel.
[3] Data does not add to total shown because of independent rounding.

tion activity of the U.S. Army Corps of Engineers in the Arkansas River Development Program. The commodity was produced in 72 of the 75 counties in the State. Cross and Miller Counties each reported production over 1 million tons and with Pulaski, Calhoun, Lafayette, and Crawford Counties, accounted for 41.8 percent of the total production. The largest single user was the Arkansas Highway Department.

Over 82 percent of the total output was classified as commercial production with a unit value of $1.20 per ton, 9 cents under that of 1967. Government-and-contractor sand and gravel output increased in unit value by 20 cents to $0.80 per ton. There were 282 sand and gravel operations in the State compared with 313 in 1967.

Soapstone.—The Milwhite Co., Inc., open pit mine, Saline County, was the only soapstone producer during 1968. Both production and value decreased about 17 percent. Produced soapstone was transported to Bryant for processing. Principal uses of the commodity were in manufacture of roofing compound and as a filler in insecticide. This was the 16th consecutive year of production from Saline County.

Stone.—Production of stone decreased 6.5 percent in volume and 4.2 percent in value. Output decreased for the third consecutive year and this commodity dropped from second to fourth in mineral value. A revision in accounting procedures resulted in reporting stone production from fewer operations in 1968 than in 1967.

Table 14.—Stone sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	20,241	$26,172
1965	21,241	26,778
1966	19,109	24,588
1967	17,454	23,236
1968	16,322	22,256

Sandstone output of 6.5 million tons (valued at $8.7 million) from 26 counties, represented the largest share of production and was used principally for road aggregate, concrete aggregate, riprap, and railroad ballast. About 5 million tons of limestone valued over $6.2 million was second in volume and value. Limestone was produced in 13 counties and was used for road aggregate, concrete aggregate, building, and riprap, in addition to cement and lime manufacture. The remaining tonnage and value was from marble, syenite, and slate. Marble was produced in Independence County by Batesville Marble Co.; Pulaski County was credited with all the syenite production. Slate was produced in Howard, Montgomery, and Saline Counties, and used principally for granules. No shell production was reported during the year.

Sulfur (Recovered Elemental).—Sulfur recovered from the treatment of sour gas at three plants in Lafayette, Columbia, and Union Counties, was about 3 percent lower than in 1967. Value, however, increased by 19 percent reflecting higher unit prices. Olin Mathieson Chemical Corp. was the leading producer of recovered sulfur during the year.

Tripoli.—Industrial Minerals, Inc., and Malvern Minerals Co. were the two producers of tripoli during 1968. Output and value increased substantially due to new production in Polk County. Tripoli was mined by open pit methods in Garland and Polk Counties and processed at Dierks and Hot Springs, Ark. Principal use was for abrasives.

METALS

Bauxite continued as the principal metal-bearing ore mined. With the startup of Union Carbide Corp.'s mine-mill complex in Garland County, Arkansas joined other domestic producers of vanadium and became second in volume produced. Mercury production (reported during 1967) was not reported during 1968.

Aluminum.—Two primary aluminum production plants, Jones Mills at Malvern and Robert P. Patterson at Arkadelphia, continued processing alumina to aluminum. Plants were in operation rolling, drawing, and extruding aluminum. General Cable Corp.'s Hot Springs plant produced wire and cable; Revere Copper and Brass' Newport plant produced aluminum foil; Reynolds Cable Co.'s Malvern plant produced cable; and Southern Extrusions, Inc.'s, Magnolia plant produced aluminum extrusions. The Dow Chemical Co. began construction of a $7 million aluminum extrusion plant at Russellville, Ark., and startup was scheduled for mid-1969. There were numerous foundries producing aluminum castings and other industries using primary aluminum.

Bauxite.—Output and value of bauxite increased. Although output increased less than 1 percent, value increased by 26.2 percent, reflecting a relatively large increase in unit price. Arkansas continued to lead other states in bauxite production with 95 percent of the U.S. total.

Table 15.—Bauxite mine production and shipments from mines and processing plants to consumers

(Thousand long tons and thousand dollars)

Year	Mine production			Shipments		
	Crude	Dry equivalent	Value	As shipped	Dry equivalent	Value
1964	1,864	1,562	$17,431	1,773	1,531	$17,859
1965	1,911	1,593	17,974	2,100	1,803	20,786
1966	2,060	1,718	19,439	1,986	1,708	20,258
1967	1,943	1,571	18,269	2,137	1,815	21,927
1968	1,961	1,582	23,058	2,097	1,756	26,040

There were four crude bauxite producers with a total of five operations during 1968: Reynolds Mining Corp. (two operations), Alcoa, American Cyanamid Co., and A. P. Green Refractories. Three bauxite plants were operating: American Cyanamid Co.'s Benton plant in Saline County produced calcined bauxite; Porocel Corp.'s Berger plant and Stauffer Chemical Co.'s Peiser Spur plant, both in Pulaski County, produced activated bauxite. In Saline County two plants, the Alcoa plant and Reynolds Metals Co.'s Hurricane Creek plant, processed bauxite to alumina. Alumina produced in Arkansas was primarily used for production of aluminum; however, significant amounts were used in abrasives, chemicals, refractories, ceramics, and other industrial uses.

Mercury.—No mercury output was reported; however, the Arkansas Geological Commission was conducting a corehole and sampling study, to be concluded in 1969, to determine cinnabar resources in Pike County.

Vanadium.—In May, Union Carbide Corp. began operation of its Garland County vanadium extraction mill designed to treat 1,600 tons of vanadium-bearing ore daily. At capacity the plant can produce 16 tons of vanadium oxide per day, utilizing a high-temperature salt-roast process which yields a 99.9 percent pure product. This mine-mill complex was the first in the United States to produce vanadium oxide as its major product. The vanadium oxide was shipped to Union Carbide's Marietta, Ohio, plant for conversion prior to marketing.

The Garland County vanadium deposit is associated with alkali igneous rocks and is the only such known domestic deposit. Two open pit mines adjacent to the plant were in operation during the year and supplied the necessary ore. Arkansas ranked second in domestic vanadium production.

Table 16.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Arkansas Oilstone Co., Inc.	Hot Springs, Ark. 71901	Mine and plant	Garland.
Norton Pike Div. Co	Littleton, N.H. 03561	Mine	Do.
Barite:			
Dresser Minerals	Houston, Tex. 77005	Mine and plant	Hot Spring.
National Lead Co	----do------77001	----do	Do.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Bauxite:			
Aluminum Co. of America	Pittsburgh, Pa. 15219	Mine	Saline.
American Cyanamid Co	Wayne, N.J. 07472	Mine and plant	Do.
Porocel Corp	Menlo Park, N.J. 08837	Plant	Pulaski.
Reynolds Mining Corp	Richmond, Va. 23218	Mine and plant	Saline.
Stauffer Chemical Co	Little Rock, Ark. 72206	Plant	Pulaski.
Bromine:			
Arkansas Chemicals, Inc	El Dorado, Ark. 71730	Brine wells and plant.	Union.
The Dow Chemical Co	Midland, Mich. 48640	do	Columbia.
Great Lakes Chemical Corp	West Lafayette, Ind. 47901	do	Union.
Michigan Chemical Corp	Chicago, Ill. 60606	do	Do.
Cement:			
Arkansas Cement Corp	Foreman, Ark. 71836	Mine and plant	Little River.
Ideal Cement Co	Denver, Colo. 80202	do	Howard.
Clays:			
Acme Brick Co	Fort Worth, Tex. 76101	do	Hot Spring and Sebastian.
Arkansas Lightweight Aggregate Corp.	England, Ark. 72046	do	Lonoke.
Do	do	do	Crittenden.
W. S. Dickey Clay Mfg. Co	Kansas City, Mo. 64105	do	Miller and Polk.
El Dorado Brick Co	El Dorado, Ark. 71731	do	Union.
Eureka Brick & Tile Co	Clarksville, Ark. 72830	do	Johnson.
Hope Brick Works	Hope, Ark. 71801	do	Clark, Hempstead, and Ouachita.
A. P. Green Refractories Co	Mexico, Mo. 65265	do	Saline and Pulaski.
Malvern Brick & Tile Co	Malvern, Ark. 72104	do	Hot Spring.
Wheeler Brick Co., Inc	Jonesboro, Ark. 72401	do	Craighead.
Coal:			
Dixie Construction Co	Fort Smith, Ark. 72901	Mine	Johnson.
Garland Coal & Mining Co	do	do	Franklin.
Hilton Coal Co., Inc	Clarksville, Ark. 72830	do	Johnson.
Johnson Coal Co., Inc	do	do	Do.
F. S. Neely Coal Co	Fort Smith, Ark. 72901	do	Sebastian.
Prairie Coal Co., Inc	Clarksville, Ark. 72830	do	Johnson.
Excelsior Valley Coal Co	Midland, Ark. 72945	do	Sebastian.
Gypsum:			
Dierks Forests, Inc	Hot Springs, Ark. 72901	Mine and plant	Howard.
Dulin Bauxite Co., Inc	do	do	Pike.
Lime:			
Aluminum Co. of America	Pittsburgh, Pa. 15219	Plant	Saline.
Rangaire Corp., Batesville White Lime Div.	Batesville, Ark. 72501	do	Independence.
Reynolds Mining Co	Richmond, Va. 23226	do	Saline.
Sand and gravel:			
Arkhola Sand & Gravel Co	Fort Smith, Ark. 72901	Dredge and plant	Crawford.
Big Rock Stone & Material Co.	Little Rock, Ark. 72203	do	Pulaski.
Braswell Sand & Gravel Co	Minden, La. 71055	do	Sevier.
Gifford-Hill & Co., Inc	Dallas, Tex. 75247	Mine and plant	Lafayette and Miller.
Humphries & Kail	Earle, Ark. 72331	do	Cross.
Mobley Construction Co., Inc.	Morrilton, Ark. 72110	Dredge and plant	Pope, Yell, and Jackson.
Pine Bluff Sand & Gravel	Pine Bluff, Ark. 71601	do	Ouachita and Jefferson.
St. Francis Material Co	Forrest City, Ark. 72335	Mine and plant	Ashley, Calhoun, Craighead, Poinsett, and St. Francis.
Silica Products Co., Inc	Guion, Ark. 72540	do	Izard.
Stone:			
Acme Material Co	Little Rock, Ark. 72203	Quarry	White.
Anderson-Oxandale Co	Herington, Kans. 67449	do	Conway.
Arkhola Sand & Gravel Co	Fort Smith, Ark. 72901	do	Crawford.
Arkansas Limestone Div., Rangaire Corp.	Batesville, Ark. 72501	do	Izard.
Batesville White Lime Div., Rangaire Corp.	do	do	Independence.
Big Rock Stone & Material Co.	Little Rock, Ark. 72203	do	Pulaski.
Bird & Son, Inc	Glenwood, Ark. 71943	do	Montgomery.
Black Rock Limestone Products Co.	Little Rock, Ark. 72203	do	Lawrence.
Cabot Quarries, Inc	do	do	Faulkner, Johnson, Perry, Pulaski, and Sebastian.
Love Hollow Limestone Div., Rangaire Corp.	Batesville, Ark. 72501	do	Izard.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
G. P. Freshour	Sweet Home, Ark. 72164	Quarry	Cleburne, Faulkner, Johnson, Newton, Pope, Pulaski, and Sebastian.
Freshour Construction Co., Inc.	do	do	Baxter, Conway, Faulkner, Franklin, Fulton, Johnson, Polk, Scott, Yell, and White.
Freshour Corp	do	do	Conway, Franklin, Independence, Izard, Johnson, Newton, Polk, Randolph, Scott, Sharp, Stone, and Yell.
Ben Hogan Co., Inc	Little Rock, Ark. 72203	do	Garland, Conway, and Pope.
Jeffrey Stone Co., Inc	North Little Rock, Ark. 72114	do	Pulaski.
McClinton Bros. Co	Fayetteville, Ark. 72701	do	Benton and Washington.
Midwest Lime Co	Batesville, Ark. 72501	do	Independence.
Talc and soapstone: The Milwhite Co., Inc.	Houston, Tex. 77020	Mine and plant	Saline.
Tripoli:			
Industrial Minerals, Inc	Little Rock, Ark. 72201	Mine	Polk.
Malvern Minerals Co	Hot Springs, Ark. 71901	do	Garland.
Natural gas liquids:			
Arkla Chemical Corp	Magnolia, Ark. 71753	Plant	Columbia.
Austral Oil Co., Inc	Stamps, Ark. 71860	do	Lafayette.
Phillips Petroleum Co	do	do	Do.
Sun Oil Co., DX Div	do	do	Do.
Petroleum:			
American Oil Co	El Dorado, Ark. 71730	Refinery	Union.
Berry Petroleum Co	Magnolia, Ark. 71753	do	Columbia.
Cross Oil & Refining Co. of Arkansas.	Smackover, Ark. 71762	do	Union.
Lion Oil, Div. Monsanto Co	El Dorado, Ark. 71730	do	Do.
Macmillan Ring-Free Oil Co., Inc.	Norphlet, Ark. 71759	do	Do.

The Mineral Industry of California

This chapter has been prepared under a cooperative agreement for the collection of mineral data between the Bureau of Mines, U.S. Department of the Interior, and the California Department of Conservation, Division of Mines and Geology.

By Francis C. Mitko [1]

California's mineral production reached an alltime high of $1.81 billion in 1968, exceeding the previous high of $1.71 billion recorded for 1966. The value of production was 7 percent higher than in 1967, with gains reported for mineral fuels (6 percent), nonmetals (7 percent), and metals (13 percent). Mineral fuels accounted for 65 percent, nonmetals for 30 percent, and metals for 5 percent of the State's 1968 mineral production.

Consumption, Trade, and Markets.—California consumed more mineral raw materials than any other State. Despite the diversity and abundance of its mineral production (the State produced 48 commodities and ranked third in the Nation in total value of minerals produced), California had to obtain several commodities from out-of-State. It was the sixth highest State in natural gas production, yet more than 1,415 billion cubic feet of natural gas was received from outside the State, and natural gas receipts (pipeline) from out-of-State rose 6 percent. Plants within the State processed 28 billion cubic feet less of wet gas than in 1967, but the output of natural gas liquids, including condensate, declined only slightly. California ranked third in petroleum production and first in petroleum consumption. Refinery receipts of petroleum from all sources rose 1 percent.

California was the sole domestic source of boron minerals and compounds and the leader by far in sand and gravel output, short-fiber asbestos, diatomite, mercury, rare-earth minerals and compounds, salt cake, and tungsten. Plants in California also processed many other nonmetallic minerals produced in other States, principally Arizona and Nevada.

Trends and Developments.—For the first time, petroleum production in California exceeded 1 million barrels per day for the entire year. Oil production from offshore wells reached 247,000 barrels daily at yearend, comprising 24.2 percent of the State total, up from 20.2 percent in 1967. New wells in the Santa Barbara Channel on Federal acreage leased in 1966 contributed more than 2 million barrels to the State's supply of oil. At a Federal lease sale in 1968, 363,181 acres of offshore lands in the Santa Barbara Channel was leased for cash bonuses totaling nearly $603 million. At yearend, 22 wells had been drilled on these newly leased tracts, and three new offshore oil pools had been discovered.

The State's first commercial phosphate producer, Cuyama Phosphate Corp., Santa Barbara County, began mining and crushing a phosphatic rock to be used as a soil additive. Reserve Oil & Gas Co. began constructing a plant in Hanford, Kings County, to produce an ammonium sulfate soil conditioner by the reaction of gypsum with ammonia and carbon dioxide. Standard Oil Co. of California began recovering ammonium sulfate from the waste water of its Richmond, Contra Costa County, refinery. Stauffer Chemical Co. announced that it would build a plant in Martinez, Contra Costa County, to produce sulfuric acid by roasting pyrite ore from its mine in Shasta, Calif. The plant also was to regenerate spent acid from nearby oil refineries. Casino Silver Mines, Ltd., ac-

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[1] **Economist, Bureau of Mines, San Francisco Office of Mineral Resources.**

Table 1.—Mineral production in California[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Asbestos short tons	77,091	$6,726	75,592	$6,139
Barite (crude) thousand short tons	10	71	W	W
Boron minerals short tons	955,000	74,130	1,026,000	79,827
Cement thousand 376-pound barrels	42,034	137,961	47,595	151,961
Clays thousand short tons	2,609	6,037	2,755	6,630
Copper (recoverable content of ores, etc.) short tons	788	602	1,182	989
Feldspar long tons	94,769	W	W	W
Gem stones	NA	200	NA	200
Gold (recoverable content of ores, etc.) troy ounces	40,570	1,420	15,682	[2] 616
Gypsum thousand short tons	1,241	3,150	1,360	3,603
Lead (recoverable content of ores, etc.) short tons	1,735	486	4,001	1,057
Lime thousand short tons	539	8,696	568	9,301
Magnesium compounds from sea-water bitterns (partly estimated) short tons, MgO equivalent	76,592	6,882	81,622	7,229
Mercury 76-pound flasks	16,385	8,018	21,417	11,470
Natural gas million cubic feet	681,080	202,290	714,893	221,077
Natural gas liquids:				
Natural gasoline and cycle products thousand 42-gallon barrels	r 14,605	r 46,620	13,403	42,963
LP gases do	8,730	19,065	8,589	18,749
Peat short tons	30,014	396	W	W
Perlite do	W	W	8,806	80
Petroleum (crude) thousand 42-gallon barrels	359,219	829,133	375,496	888,644
Pumice, pumicite, and volcanic cinder thousand short tons	866	1,357	776	1,312
Salt (common) do	1,732	W	1,901	W
Sand and gravel do	116,125	139,212	124,655	153,360
Silver (recoverable content of ores, etc.) thousand troy ounces	145	224	598	1,282
Stone[3] thousand short tons	37,186	55,263	36,125	52,671
Sulfur ore long tons	568	3	3,125	46
Talc, pyrophyllite, and soapstone short tons	143,466	1,945	165,396	2,075
Zinc (recoverable content of ores, etc.) do	441	122	3,525	952
Value of items that cannot be disclosed: Bromine, calcium chloride, carbon dioxide, coal (lignite), diatomite, iron ore, lithium minerals, mica (scrap), molybdenum, phosphate rock (1968), platinum-group metals, potassium salts, rare-earth metals, sodium carbonate, sodium sulfate, tin concentrates (1967), tungsten concentrates, wollastonite, and values indicated by symbol W	XX	143,722	XX	150,914
Total	XX	r 1,693,731	XX	1,808,147
Total 1957–59 constant dollars	XX	r 1,615,781	XX	p 1,721,690

p Preliminary. r Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Based on average U.S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968, and the New York selling price for the remainder of the year.

[3] Includes slate.

Table 2.—Value of mineral production in California, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Alameda	$23,791	$26,628	Sand and gravel, salt, stone, magnesium compounds, petroleum, clays, lime, bromine.
Alpine	79	W	Silver, gold, lead, zinc, copper.
Amador	3,203	3,394	Sand and gravel, clays, coal (lignite), soapstone, gold, silver, stone.
Butte	3,903	3,025	Natural gas, sand and gravel, volcanic cinder, gold, stone.
Calaveras	18,216	14,558	Cement, asbestos, stone, clays, sand and gravel.
Colusa	4,428	4,234	Natural gas, sand and gravel, stone, mercury.
Contra Costa	r 16,136	13,813	Natural gas, stone, petroleum, sand and gravel, lime, clays, peat, mercury.
Del Norte	990	534	Sand and gravel, stone.
El Dorado	2,573	2,490	Stone, lime, sand and gravel, soapstone, gold, silver.
Fresno	72,979	64,809	Petroleum, sand and gravel, natural gas, natural gas liquids, asbestos, stone, mercury, gold, clays, tungsten, silver.
Glenn	5,065	4,184	Natural gas, sand and gravel, lime.

See footnotes at end of table.

Table 2.—Value of mineral production in California, by counties—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Humboldt	$2,442	$2,406	Natural gas, stone, sand and gravel, clays.
Imperial	5,932	4,058	Gypsum, sand and gravel, calcium chloride, lime, clays, stone, silver, gold.
Inyo	23,790	28,585	Tungsten, talc, silver, mercury, lead, copper, zinc, stone, sand and gravel, molybdenum, sodium carbonate, perlite, sulfur, volcanic cinder, clays, boron, gold, wollastonite.
Kern	r 424,746	451,751	Petroleum, boron, natural gas, cement, natural gas liquids, sand and gravel, stone, gypsum, sodium sulfate, clays, salt, carbon dioxide, iron ore, pumicite and volcanic cinder, silver, gold, tungsten, copper, lead, zinc.
Kings	13,509	13,917	Natural gas, natural gas liquids, petroleum, sand and gravel, mercury.
Lake	1,256	957	Sand and gravel, mercury, volcanic cinder, clays, stone.
Lassen	436	1,197	Sand and gravel, volcanic cinder.
Los Angeles	319,727	380,444	Petroleum, sand and gravel, natural gas, natural gas liquids, stone, clays, lead, soapstone, gold, copper, zinc, mica, silver.
Madera	2,779	1,964	Sand and gravel, natural gas, tungsten, stone, volcanic cinder, clays.
Marin	2,397	2,955	Stone, mercury, sand and gravel, clays.
Mariposa	126	161	Sand and gravel, stone, gold, silver.
Mendocino	1,142	671	Sand and gravel, stone, mercury.
Merced	3,846	W	Sand and gravel, gypsum, gold, silver.
Modoc	758	496	Sand and gravel, volcanic cinder, stone.
Mono	423	747	Sand and gravel, pumice and volcanic cinder, clays, pyrophyllite, stone, copper, silver.
Monterey	37,004	36,286	Petroleum, magnesium compounds, lime, sand and gravel, stone, feldspar, natural gas.
Napa	3,179	3,025	Mercury, stone, salt, clays, sand and gravel, diatomite, pumice.
Nevada	1,083	739	Sand and gravel, stone, gold, silver.
Orange	119,221	113,394	Petroleum, sand and gravel, natural gas, natural gas liquids, clays, lime, salt, peat.
Placer	912	958	Sand and gravel, clays, stone, gold.
Plumas	515	232	Sand and gravel, copper, gold, stone, silver, clays.
Riverside	72,027	74,416	Iron ore, cement, sand and gravel, stone, clays, natural gas, petroleum, wollastonite.
Sacramento	r 19,558	29,719	Natural gas, sand and gravel, petroleum, gold, clays, silver.
San Benito	10,483	12,081	Mercury, cement, stone, asbestos, sand and gravel, petroleum, natural gas, clays, silver.
San Bernardino	113,356	126,348	Cement, boron, sand and gravel, stone, rare-earth minerals, sodium sulfate, sodium carbonate, potassium salts, salt, iron ore, lime, clays, lithium minerals, talc and pyrophyllite, calcium chloride, bromine, tungsten, petroleum, pumice and volcanic cinder, gypsum, natural gas, copper, silver.
San Diego	14,517	16,262	Sand and gravel, stone, magnesium compounds, salt, clays, pyrophyllite, gold, silver.
San Francisco	W	W	Sand and gravel.
San Joaquin	10,630	14,059	Natural gas, sand and gravel, lime, clays, gold, silver.
San Luis Obispo	6,384	5,876	Petroleum, mercury, sand and gravel, stone, natural gas, gypsum, clays.
San Mateo	14,316	14,805	Cement, salt, magnesium compounds, stone, petroleum, sand and gravel, clays, natural gas.
Santa Barbara	r 130,561	124,943	Petroleum, natural gas, diatomite, natural gas liquids, sand and gravel, mercury, lime, stone, phosphate rock.
Santa Clara	32,952	34,916	Cement, stone, sand and gravel, mercury, copper, petroleum, gold, silver.
Santa Cruz	12,501	13,938	Cement, sand and gravel, stone, clays.
Shasta	6,786	7,307	Cement, sand and gravel, stone, clays, volcanic cinder, barite, lead, silver, diatomite, zinc, gold, copper.
Sierra	277	1,302	Sand and gravel, gold, stone, silver.
Siskiyou	1,174	2,203	Sand and gravel, stone, pumice and volcanic cinder, gold.
Solano	r 13,052	16,591	Natural gas, stone, petroleum, sand and gravel.
Sonoma	4,420	4,902	Sand and gravel, mercury, stone, clays, natural gas.
Stanislaus	1,188	1,445	Sand and gravel, clays.
Sutter	13,099	11,656	Natural gas, sand and gravel, clays.
Tehama	918	1,596	Natural gas, sand and gravel, volcanic cinder, stone.
Trinity	718	1,287	Stone, mercury, sand and gravel, gold, silver.
Tulare	2,397	2,412	Sand and gravel, natural gas, stone, petroleum, barite, clays, tungsten.
Tuolumne	1,478	1,216	Stone, lime, gold.
Ventura	87,836	93,521	Petroleum, natural gas, natural gas liquids, sand and gravel, clays, stone, gypsum.
Yolo	3,629	3,883	Sand and gravel, lime, natural gas, mercury.
Yuba	2,531	1,525	Sand and gravel, gold, stone, clays, platinum.
Undistributed [1]	362	7,831	
Total	r 1,693,731	1,808,147	

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r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes petroleum, natural gas, gem stones, tungsten, and gold that cannot be assigned to specific counties and values indicated by symbol W.

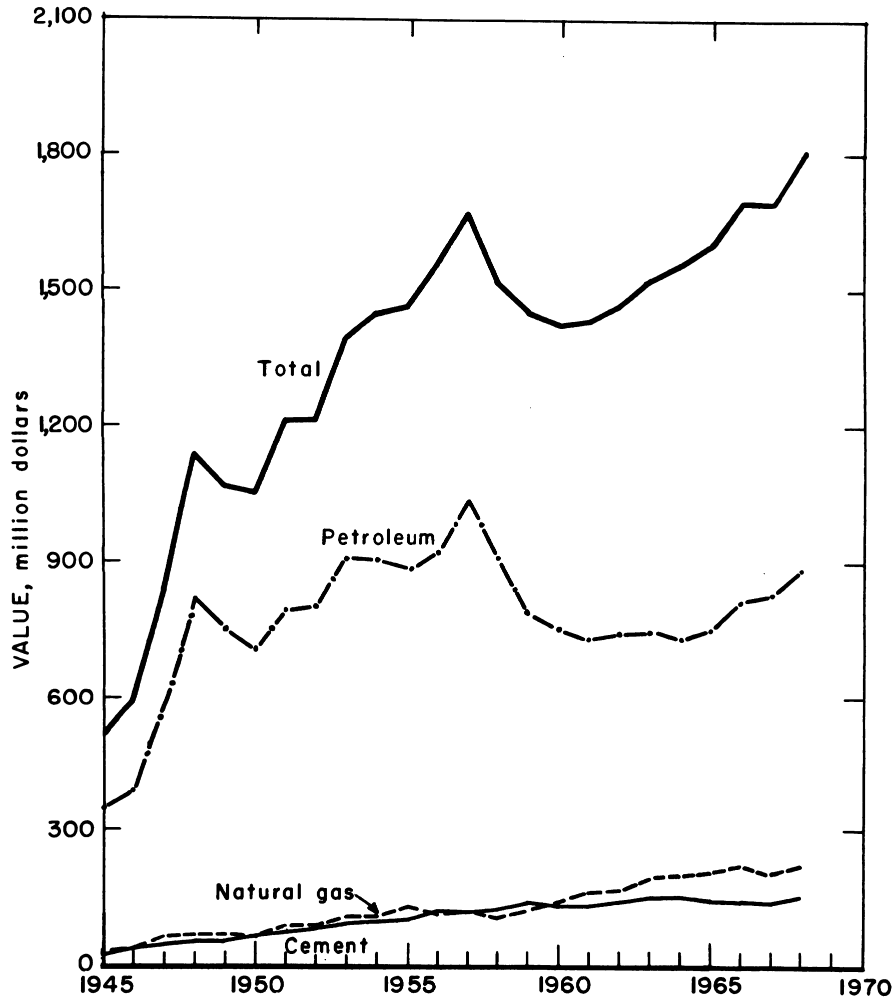

Figure 1.—Value of petroleum, natural gas, cement, and total value of mineral production in California.

quired an option to purchase a two-thirds interest in the Leviathan Sulfur mine in Alpine County, from United States Borax & Chemical Corp., which would retain a one-third interest. Officials reported that if a pilot project for refining sulfur produced favorable results, Casino and United States Borax jointly would develop the Leviathan property. Columbian Carbon Co. was building a 60-million-pound-per-year carbon black plant near Mojave, Kern County.

A new mercury producer, the El Capitan mine in Death Valley, Inyo County, began operating early in January, and in 4 months reportedly produced 1,000 flasks of mercury. New Idria Mining and Chemical Co. exercised its option to buy the New Almaden mercury mine property 9 miles south of San Jose, Santa Clara County. Phillips Petroleum Co. acquired a 50-percent interest in Silver King, Inc., properties in Nevada and California. Under a 1966 agreement, Phillips and Silver King were

Table 3.—Indicators of California business activity

	1967	1968 p	Change (percent)
Employment and labor force, annual average:			
Total labor force ... thousands	7,833	8,090	+3.3
Unemployment ... do	389	366	−5.9
Civilian employment ... do	7,444	7,725	+3.8
Agriculture, forestry, and fisheries ... do	318	320	+.6
Mineral extraction ... do	33	33	--------
Contract construction ... do	339	354	+4.4
Manufacturing ... do	1,639	1,677	+2.3
Government ... do	1,273	1,334	+4.8
Trade ... do	1,554	1,620	+4.2
Services ... do	1,474	1,538	+4.3
All others ... do	814	849	+4.3
Payroll data, annual insured wages:			
Agriculture, forestry, and fisheries ... millions	$929	$1,014	+9.1
Mineral extraction ... do	$283	$303	+7.1
Contract construction ... do	$2,557	$2,857	+11.7
Manufacturing ... do	$12,844	$13,887	+8.1
Transportation, communication, and utilities ... do	$3,065	$3,387	+10.5
Wholesale and retail trade ... do	$7,769	$8,484	+9.2
Finance, insurance, and real estate ... do	$2,090	$2,357	+12.8
Services ... do	$5,211	$5,325	+2.2
State and local governments [1] ... do	$131	$138	+5.3
Personal income:			
Total ... do	$70,204	$76,100	+8.4
Per capita	$3,604	$3,847	+6.7
Construction activity:			
Portland cement plant capacity, Dec. 31 ... million barrels	62	64	+3.2
Portland cement plant production ... do	42	47	+11.9
Portland cement shipments from mills ... do	42	48	+14.3
Portland cement estimated consumption ... do	38	45	+18.4
Business receipts:			
Business taxable sales (tangible goods and services, including wholesale) ... millions	$35,122	$39,007	+11.1
Retail sales (taxable and nontaxable) ... do	$33,080	$36,949	+11.7
Farm market receipts (including government transfers) ... do	$4,031	$4,378	+8.6
Mineral production ... do	$1,694	$1,808	+6.7
Utility sales:			
Revenues of 4 privately owned electric utilities [2] ... do	$1,215	$1,271	+4.6
Revenues of 4 privately owned natural gas utilities [3] ... do	$858	$888	+3.5
Exports through California ports:			
Waterborne ... do	$2,601	$3,030	+16.5
Airborne ... do	$426	$506	+18.8
Imports through California ports:			
Waterborne ... do	$2,363	$3,102	+31.3
Airborne ... do	$243	$360	+48.1

p Preliminary.
[1] Includes nonclassifiable establishments.
[2] Constitutes 99 percent of total electrical utility sales.
[3] Constitutes 99 percent of total natural gas utility sales.

Sources: California Department of Employment, California Department of Finance, California Department of Industrial Relations, Public Utilities Commission, Economic Report to the Governor.

exploring and evaluating about 20,000 acres of unpatented mining claims and leases in Shasta County, Calif., and White Pine County, Nev. Calico Silver Mines, Ltd., reported that it was exploring claims near the foothills of the Calico Mountains, northeast of Barstow. The company reported that its drilling program indicated the presence of gold and silver to a depth of 800 feet and confirmed the feasibility of a large-volume open-pit silver operation.

The last operating gold dredge in California, and one of the last to operate in the western United States, was shut down on October 1, 1968, by Yuba Consolidated Industries, Inc. The dredge, Old "Yuba 21," was working placer ground near Hammonton, Yuba County. FMC Corp. closed its magnesium oxide plant at Newark, Alameda County. The plant had operated since 1929 and recovered magnesium oxide from sea-water bitterns obtained from a nearby plant producing salt by solar evaporation.

Several companies in California announced joint ventures to drill for geothermal steam. Geothermal Resources International, Inc., joined with Systems Capital Corp. and Vanderbilt Corp. to drill in The Geysers area, Sonoma County, and Cordero Mining Co. joined with D. D. Feldman to explore for steam in the Clear

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	6	110	1	5	-------	-------	-------	--------
Peat	30	205	6	49	-------	-------	-------	--------
Metal	2,448	244	598	4,782	8	137	30.32	10,907
Nonmetal	4,440	288	1,281	10,284	6	182	18.28	4,153
Sand and gravel	5,694	225	1,283	10,405	4	207	20.28	3,778
Stone	4,208	288	1,212	9,664	2	107	11.28	1,728
Total [1]	16,826	260	4,382	35,189	20	633	18.56	4,286
1968: p								
Coal	5	109	1	5	-------	-------	-------	--------
Peat	14	131	2	15	-------	-------	-------	--------
Metal	2,810	252	707	5,637	4	134	24.48	5,497
Nonmetal	4,620	264	1,218	9,767	-------	163	16.69	1,017
Sand and gravel	5,955	239	1,421	11,465	1	277	24.25	1,159
Stone	4,565	291	1,326	10,839	4	121	11.53	2,845
Total [1]	17,975	260	4,675	37,728	9	695	18.66	2,254

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Table 5.—Principal custom mills, commercial grinding plants, and primary smelters in 1968

Company	County	Nearest city or town	Minerals processed	Remarks
American Smelting & Refining Company.	Contra Costa	Selby	Lead, zinc, silver, gold	Smelter, refinery, and fuming plant.
The Wilbur Ellis Co	Fresno	Fresno	Nonmetals	Commercial grinding.
Standard Industrial Minerals, Inc	Inyo	Bishop	do	Do.
Paramount Pacific, Inc	Kern	Rosamond	do	Do.
American Minerals Co	Los Angeles	Los Angeles	do	Do.
Industrial Minerals Co	Sacramento	Florin	do	Do.
Kaiser Steel Corp	San Bernardino	Fontana	Iron ore	Blast furnaces, steel plants, and fabricating plants.
Chas. Pfizer & Co., Inc	do	Victorville	Nonmetals	Commercial grinding.
Western Talc Co	do	Dunn	do	Do.

Lake area, Lake County. In addition, a combination of Magma Power Co., Thermal Power Co., and Union Oil Co. of California announced in February that its first geothermal steam well of the 1968 season had come in, producing superheated steam at a rate equivalent to 10,900 kilowatts of power.

Exploration for metals and nonmetals continued at a high level, with 109 active exploration projects reported to the Bureau of Mines. Inyo and San Bernardino Counties accounted for 19 and 17 of the projects, respectively. Gold was the most actively sought commodity with 33 projects, followed by mercury with 14, tungsten with 12, talc with 11, copper with eight, silver with six, lead and limestone with four projects each, asbestos and iron with three each, clay and uranium with two each, and barite, boron, mica, nickel, potash, sulfur, and zinc with one each.

Legislation and Government Programs.—No major bills affecting mining were passed by the State Legislature in 1968. However, several bills passed in 1967 took effect in 1968, including SB 1320 concerning affidavits of annual assessment, and SB 169 concerning leases for geothermal steam exploration. These became Chapters 1132 and 1398, respectively, of the Statutes of 1967.

Public land orders by the Bureau of Land Management and other Federal agencies withdrew 75,500 acres from mine location only, and 1,500 acres from both mine location and mineral leasing, under U.S.

mining laws. Of the total withdrawn acreage, 55,000 acres remained open to mineral leasing under the Multiple Land Use Act, 46,000 acres in San Bernardino County alone. Land orders reopened 664 acres to mine location, 9,317 acres to mineral leasing, and 280 acres to both. California received U.S. Treasury checks in the amount of $3,346,596.19 in bonuses, royalties, and rentals from mineral leases and permits on Federal lands within the State, $176,020.66 more than in 1967.

The San Francisco Petroleum Research Office of the U.S. Bureau of Mines continued research to develop better methods for recovering additional oil from California fields. One method was being developed to recover black, viscous crude oil by injecting a hot, light oil (similar to kerosine) into the reservoir to dilute the heavy oil. In the proposed process, the mixture is pumped out through the same well used for injection, and the light oil is recovered in a topping plant in the field and reinjected. Investigation of secondary recovery of petroleum by waterflood continued, and other research was underway to develop better methods for recovering additional gas from fields where water moves into the reservoir as the gas is removed.

The major emphasis at the Bureau of Mines Marine Minerals Technology Center at Tiburon, Marin County, continued to be on developing equipment and techniques to accurately delineate the character of seafloor mineral deposits, a necessary first step in the evaluation process. During 1968, blanket deposits of phosphorite occurring in hundreds of feet of water off the southern California coast were investigated. At the Center, model studies were conducted on various modes of penetration to determine the nature of seafloor excavation phenomena. An understanding of these phenomena could lead to the design of marine mining systems to operate in harmony with the ocean environment.

The Bureau's San Francisco Office of Mineral Resources completed a study of the Tertiary gravels of California which led to the initiation of a 2-year mining research program to determine the feasibility of a mining system for the profitable recovery of gold in the gravels; completed the field investigation of the Emigrant Basin Primitive Area and continued fieldwork on the Salmon-Trinity Alps Primitive Area, both proposed for inclusion in the National Wilderness Preservation System; and completed a study of the petroleum production potential by waterflooding for 165 oil pools in California. Personnel also continued to collect and analyze basic information on mineral resources, mineral production, land use, and water use for an interagency river basin study of the California Region and initiated a similar study of the Great Basin Region. Another study was initiated to develop a Bureau-wide computerized mineral information storage and retrieval system.

Of the four applications received from California producers since enactment of the Lead-Zinc Stabilization Program in October 1962, one had been certified and three had been withdrawn, suspended, or disqualified. Payments totaling $19,113 were made on 550.7 tons of lead produced in California in 1968, compared with only $1,467 on 195.6 tons of lead in 1967.

The Region II Field Office, Office of Minerals Exploration (OME), U.S. Geological Survey, received 19 applications from persons interested in exploring for minerals in California under the OME program. Eight new contracts were granted—four for gold, two for gold and silver, one for silver, and one for mercury. Two of the new contracts were for exploration in San Bernardino County; single contracts were executed for exploration in Mariposa, Riverside, San Benito, Shasta, Sierra, and Tuolumne Counties. The total value of the contracts was $465,900, with Government participation of $288,075. Twelve contracts were in force on December 31, 1968.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS [2]

Carbon Black.—The Shell Chemical Co. plant at Pittsburg, Contra Costa County, discontinued production of ammonia and byproduct carbon black in 1967. Increased production at the Continental Carbon Co. and Ashland Chemical Co. (formerly United Carbon Co.) plants in Bakersfield and Mojave, Kern County, more than offset the loss. Total production of carbon black from the two plants was 6 percent higher in quantity and 17 percent higher in value than production from the three plants in 1967. Increases were reported in all grades except SRF and SAF (refractory and abrasion grades, respectively).

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[2] Prepared by Calvin H. Riggs and Richard D. Smith, petroleum engineers, Bureau of Mines, San Francisco. Calif.

Carbon Dioxide.—Getty Oil Co. and Standard Oil Co. of California extracted carbon dioxide from natural gas at natural gasoline plants near Taft, Kern County. Standard Oil Co. marketed its product for the first time in 1968. Quantity of carbon dioxide was up 28 percent and value up 43 percent from the 1967 figures. The carbon dioxide was sold for use in carbonated beverages.

Coal (Lignite).—Production and value of lignite were down sharply from the 1967 figures. Ownership of the sole California lignite mine passed from American Lignite Products Co., Inc., to Interpace Corp. The lignite was processed to recover several grades of industrial waxes.

Coke.—Kaiser Steel Corp. at Fontana, San Bernardino County, operated California's only coking facility. The coke was consumed in company blast furnaces, and coke breeze was used in the company agglomerating plant. Consumption of coke increased 5 percent, while that of coke breeze increased 6 percent, compared with 1967 levels. The coking coal was obtained from captive mines outside the State.

Natural Gas.—Marketed production of natural gas was 5 percent above that in 1967, the greatest increase being in dry gas where production from 1,094 wells in 107 fields averaged 853 million cubic feet daily. Gas wells completed during 1968 totaled 82, including 17 in the Rio Vista, nine in the Marton, and seven in the Trico Northwest fields. Ryer Island field in Solano County and Todhunter Lake field in Yolo County, which were discovered in 1967, began producing. Two other 1967 discoveries were still unproductive at yearend. The drilling of 78 exploratory wells in northern California resulted in the discovery of two new gasfields, Saxon in Yolo County and Van Sickle Island in Solano County. Six new productive zones and three extensions in older fields also were discovered. The two new fields and four of the new gas zones were not marketing gas by yearend. Sales of oil-well gas increased only slightly, but still constituted about 56 percent of the total. Gas stored in six storage fields totaled 108 billion cubic feet, a decrease of 6 billion cubic feet from the 1967 volume.

Natural Gas Liquids.—The volume of natural gas processed for natural gas liquids declined in all seven producing counties, with the total State decline amounting to 6 percent (29 billion cubic feet). The output of liquefied petroleum gas (LPG) and ethane was down 2 percent in volume and value. Declines also were reported for natural gasoline production—10 percent in volume and 9 percent in value. Condensate production, from two plants in Kern County, was down 4 percent.

Peat.—The quantity and value of peat production declined from the 1967 figures. Two deposits in Contra Costa County produced 86 percent of the total as reed-sedge material. This was shredded and packaged before shipment. Production of peat moss in Modoc County was discontinued. One producer in Orange County sold humus peat directly from the pit. All peat was used for soil improvement.

Petroleum.—Production from an average of 41,722 wells, 114 more than in 1967, increased 4 percent and for the first time averaged over 1 million barrels daily for the entire year. Major increases were recorded in the Wilmington field (Los Angeles County), up 37,000 barrels daily, and the Carpinteria offshore field (Santa Barbara County), up 12,000 barrels daily. Lesser increases in production rates were achieved in the Midway-Sunset (Kern County) and Beverly Hills (Los Angeles County) fields. Completion of 233 wells in the Wilmington field, 223 of which were on offshore islands, raised production of this field to 237,254 barrels daily during October. The Crescent Heights field, new in 1967, became the east area of the Beverly Hills field, and at yearend this enlarged field was producing about 31,000 barrels daily, up from 19,000 barrels daily in December 1967. New oil wells in all counties and new Federal offshore wells totaled 2,191, a decrease of 8 percent. The Kern River field again led the State with 497 new wells, followed by the Midway-Sunset field with 419. Average depth of all new oil wells was 2,348 feet, only slightly deeper than in 1967.

Steam injection projects totaled 229, up from 208 in 1967. Wells being used for injection totaled 9,158 compared with

Table 6.—Natural gas (marketed production) and petroleum produced in 1968, by counties

County	Average number of producing wells		Petroleum		Natural gas, marketed production			
					Oil zones		Dry gas zones	
	Oil	Dry gas	Production (thousand barrels)	Value (thousands)	Million cubic feet	Value (thousands)	Million cubic feet	Value (thousands)
Alameda	5	-------	152	$442	-------	-------	-------	-------
Butte	-------	27	-------	-------	-------	-------	8,611	$2,131
Colusa	-------	90	-------	-------	-------	-------	13,614	3,949
Contra Costa	39	59	[1] 709	[1] 2,290	2,871	$847	18,347	5,525
Fresno	2,830	3	19,378	48,931	17,315	5,108	350	105
Glenn	-------	93	-------	-------	-------	-------	12,387	3,688
Humboldt	-------	21	-------	-------	-------	-------	3,916	1,175
Kern	21,404	93	[2] 123,455	[2] 271,458	151,922	52,495	8,570	2,587
Kings	178	27	744	2,158	15,502	4,573	4,959	1,389
Los Angeles	7,716	9	127,274	309,508	94,825	27,980	721	213
Madera	-------	23	-------	-------	-------	-------	1,749	516
Monterey	925	-------	14,276	22,876	2,969	876	-------	-------
Orange	3,797	1	38,472	89,243	25,060	7,387	149	44
Riverside	5	3	33	72	1	([3])	479	134
Sacramento	-------	141	[1] 35	[1] 119	-------	-------	60,755	22,020
San Benito	28	4	74	222	46	14	169	42
San Bernardino	22	-------	42	117	10	3	-------	-------
San Joaquin	-------	101	-------	-------	-------	-------	34,834	9,510
San Luis Obispo	172	-------	1,928	3,262	799	234	-------	-------
San Mateo	13	-------	26	702	1	([3])	-------	-------
Santa Barbara	1,639	17	[1] 25,090	[1] 57,423	54,607	16,109	39,758	11,729
Santa Clara	1	-------	1	2	-------	-------	-------	-------
Solano	-------	145	[1] 100	[1] 340	-------	-------	52,498	15,601
Sonoma	-------	5	-------	-------	-------	-------	25	6
Sutter	-------	143	-------	-------	-------	-------	40,387	11,515
Tehama	-------	33	-------	-------	-------	-------	4,042	1,198
Tulare	20	30	40	80	-------	-------	2,751	743
Ventura	2,905	4	21,492	68,809	36,022	10,626	578	171
Yolo	-------	22	-------	-------	-------	-------	1,671	446
Federal offshore	23	-------	2,175	5,590	1,623	438	-------	-------
Total	41,722	1,094	375,496	883,644	403,573	126,690	311,320	94,387

[1] Includes field condensate.
[2] Excludes plant condensate.
[3] Less than ½ unit.

Table 7.—Production of natural gas liquids, by counties

(Thousand 42-gallon barrels and thousand dollars)

County	LP gases and ethane			Natural gasoline and isopentane		Plant condensate	
	Number of plants	Quantity	Value	Quantity	Value	Quantity	Value
1967:							
Fresno	2	W	W	W	W	--------	--------
Kern	19	2,866	$6,510	3,226	$11,226	[r] 600	[r] $2,010
Kings	3	W	W	W	W	--------	--------
Los Angeles	18	1,332	2,760	3,528	11,314	--------	--------
Orange	5	408	816	2,254	7,091	--------	--------
San Luis Obispo	1	W	W	W	W	--------	--------
Santa Barbara	6	1,418	3,081	1,627	5,338	--------	--------
Ventura	10	1,410	2,620	2,256	5,841	--------	--------
Undistributed	------	1,296	3,278	1,114	3,800	--------	--------
Total	64	8,730	19,065	14,005	44,610	[r] 600	[r] 2,010
1968:							
Fresno	7	W	W	W	W	--------	--------
Kern	17	2,250	5,323	4,211	14,003	575	1,956
Kings	2	W	W	W	W	--------	--------
Los Angeles	23	2,076	4,550	1,958	5,938	--------	--------
Orange	5	1,325	2,852	599	1,755	--------	--------
Santa Barbara	7	998	2,242	2,308	7,254	--------	--------
Ventura	15	1,327	2,349	2,071	5,636	--------	--------
Undistributed	------	613	1,433	1,681	6,421	--------	--------
Total	76	8,589	18,749	12,828	41,007	575	1,956

[r] Revised.
W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Table 8.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1968

County	Drilling [1] [2]							
	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Alameda	1	1	5	-------	1	9	17	62,787
Butte	-------	4	1	-------	-------	3	8	39,829
Colusa	-------	-------	1	-------	-------	3	4	23,612
Contra Costa	6	6	4	-------	-------	10	26	146,658
Fresno	122	-------	9	-------	-------	17	148	377,127
Glenn	-------	2	-------	-------	-------	1	3	18,225
Humboldt	-------	-------	-------	-------	-------	1	1	3,096
Imperial	-------	-------	-------	-------	-------	1	1	1,162
Kern	1,294	2	51	11	-------	92	1,450	2,486,534
Kings	2	10	3	-------	-------	6	21	104,380
Los Angeles:								
Onshore	177	-------	4	-------	-------	14	195	1,112,896
Offshore [3]	223	-------	-------	-------	-------	1	224	998,098
Madera	-------	-------	-------	-------	-------	1	1	4,166
Merced	-------	-------	-------	-------	-------	4	4	21,713
Monterey	45	-------	2	2	-------	15	64	147,408
Orange:								
Onshore	110	-------	3	-------	-------	4	117	226,296
Offshore [3]	57	-------	2	-------	-------	-------	59	240,924
Riverside	3	-------	2	1	-------	3	9	26,018
Sacramento	-------	1	1	-------	-------	9	11	59,182
San Benito	1	-------	-------	-------	-------	3	4	11,009
San Bernardino	-------	-------	-------	-------	-------	2	2	3,077
San Joaquin	-------	7	10	-------	1	23	41	244,628
San Luis Obispo	18	-------	1	-------	-------	4	23	54,483
San Mateo	-------	-------	-------	-------	-------	2	2	6,688
Santa Barbara:								
Onshore	40	-------	-------	-------	-------	10	50	179,902
Offshore [3]	17	1	-------	-------	-------	1	19	124,376
Santa Clara	-------	-------	-------	-------	-------	1	1	1,200
Solano	3	19	4	2	1	10	39	310,175
Sonoma	-------	-------	1	-------	-------	-------	1	309
Stanislaus	-------	-------	-------	-------	-------	1	1	5,684
Sutter	-------	3	7	-------	1	8	19	133,418
Tehama	1	6	5	-------	-------	4	16	76,596
Tulare	-------	2	-------	-------	-------	19	21	59,945
Ventura:								
Onshore	47	-------	5	2	-------	6	60	318,549
Offshore [3]	-------	-------	-------	-------	-------	3	3	48,034
Yolo	-------	7	4	-------	2	18	31	184,539
Federal offshore	3	-------	-------	3	-------	17	23	206,615
Total	2,170	71	125	21	6	326	2,719	8,064,328

[1] Sources: American Association of Petroleum Geologists and U.S. Bureau of Mines.

[2] Does not include 30 stratigraphic and core tests (244,805 feet), 139 service wells (452,679 feet), or 45 wells standing suspended at yearend (195,072 feet).

[3] State leases. Federal offshore shown separately.

9,955 in 1967. Injection projects were started in nine new pools and suspended in nine other pools. Oil production resulting from steam injection continued to increase in the Midway-Sunset field and remained steady in the Kern River field. Of significance was the conversion of six projects in these fields from steam cycle to steam flooding. Only 13 in-situ combustion projects, with 116 wells in seven fields, were being operated by 10 companies, compared with 22 projects in 13 fields during 1967.

The California Division of Oil and Gas reported 251 active waterflooding projects, nine more than in 1967, with 2.2 million barrels of water being injected daily into 1,607 wells, 47 more than in 1967. Eighteen new projects were started, including one in which organic polymers were added to the flood water to increase oil recovery. About 272 million cubic feet of gas per day was being injected into 94 wells on 34 projects in 25 fields to increase oil recovery.

Exploratory drilling in 353 wells seeking new production totaled over 2 million feet, an increase of 8 percent over the 1967 footage. Of these, 27 were discovery wells for a success ratio of 7.6 percent, down from 8.2 percent in 1967. New oilfields or new reservoirs in older fields were discovered by 21 of these wells, and six wells discovered new gasfields or pools. Three of these wells discovered new oil reservoirs on Federal lands offshore from Santa Barbara County. New oilfields include Union Station, Los Angeles County, and Beer Nose and McClung fields, Kern County. New oil pools were discovered during the year in the following oilfields: Wilmington (four new pools) and Salt Lake (one pool) in Los Angeles County; Santa Maria Valley, Clark area, in Santa Barbara County; and Brentwood (two pools) in Contra Costa County. New gas reservoirs were discovered at Saxon in Yolo County; Van Sickle Island in Solano County; Prado Corona in Riverside County; Brentwood and River Break in Contra Costa County; and as an extension to Todhunters Lake in Yolo County.

Crude oil refining capacity was increased during 1968 to about 1,527,000 barrels per calendar day. Almost all of the gain in crude capacity was the result of expansion projects, largest of which was at the Standard Oil Co. of California plant in El Segundo, Los Angeles County.

Other capacity increases were for Mobil Oil Corp. at Torrance, Los Angeles County (13,000 barrels), Phillips Petroleum Co. at Martinez, Contra Costa County (10,000 barrels), and Powerine Oil Co. at Santa Fe Springs, Los Angeles County (5,000 barrels).

Construction of the Humble Oil & Refining Co. plant at Benicia was progressing on schedule and was planned for completion during 1969.

NONMETALS

Asbestos.—Four companies produced chrysotile fibers—Pacific Asbestos Corp., Calaveras County; Atlas Asbestos Co. and Coalinga Asbestos Co., Fresno County; and Union Carbide Corp., San Benito County. The San Benito County output was processed by Union Carbide in a Monterey County plant. Pacific Asbestos Corp., the largest producer, prepared and shipped groups 4, 5, 6, and 7 fibers; the others produced group 7 fibers only. Although some of the companies showed increases, the State's total quantity and value of asbestos production declined. Since California normally produces approximately two-thirds of domestic asbestos, the decline was of national significance.

Barite.—Sales of crude barite declined sharply. All the crude barite sold was for drilling mud and came primarily from two companies, Yuba Minerals & Milling Co., Shasta County, and the Embree property, Tulare County. Six producers crushed or ground California and Nevada barite in California in 1968. Most of the crushed barite sold or used was chemical grade.

Boron Minerals and Compounds.—California continued to be the principal world source, and the only domestic source, of boron minerals and compounds. Nearly all of the output came from two locations: The United States Borax & Chemical Corp. pit near Boron, Kern County; and Searles Lake, San Bernardino County, where two companies, American Potash & Chemical Corp., Division of Kerr-McGee Corp., and Stauffer Chemical Co. extracted borates from brines pumped through subsurface crystalline deposits. U.S. Borax operations included process plants at the mine site and at Wilmington, Calif. Stauffer, in addition to its process plant at Searles Lake, produced boron products at a San Francisco plant from purchased borates. A small tonnage of colemanite was produced from open-pit operations in the Furnace Creek area of Death Valley, Inyo County, and sold to the Atomic Energy Commission.

Bromine and Bromine Compounds.—The Trona plant of American Potash & Chemical Corp., division of Kerr-McGee Corp., recovered elemental bromine from Searles Lake brines in San Bernardino County and sold it to the chemical and pharmaceutical industries. Production declined 5 percent in value. The Newark, Alameda County, plant of FMC Corp. ceased operations in August. Until then it recovered elemental bromine from saltworks bitterns and converted it to ethylene dibromide. The output, value of which was down 58 percent from that of 1967, was sold principally for use as a soil fumigant.

Calcium Chloride.—Four companies produced calcium chloride: Chloride Products, Inc., and Imperial Thermal Products, Inc., produced from well brines in Imperial County; Leslie Salt Co. and National Chloride Company of America produced from Bristol Lake brines in San Bernardino County. Value of output was up by 27 percent and quantity by 10 percent. Calcium chloride was used for fireproofing and as a hydroscopic agent.

Cement.—Shipments of portland cement from 14 plants were nearly 47.6 million barrels, of which 3.9 million barrels went to out-of-State customers. California customers received 943,000 barrels of cement from producers outside the State. Total apparent consumption of domestic cement in California was a record 44.6 million barrels. Deliveries to ready-mixed concrete companies and direct sales to highway and other contractors accounted for much of the increase. Losses were recorded only in sales of cement to building material dealers. Bulk shipments from California plants increased from 36.9 million barrels in 1967 to 42.7 million barrels. Bag shipments declined from 5.1 million barrels in 1967 to 4.9 million.

Completion of long-range expansion projects at several plants in southern California increased the State's annual cement production capacity to 64.3 million barrels as of December 31.

Table 9.—Finished portland cement

(Thousand 376-pound barrels and thousand dollars)

District [1]	Active plants	Rated capacity Dec. 31	Production	Shipments from mills			Stocks at mills Dec. 31	Apparent consumption [2]
				Quantity	Value			
					Total	Average per barrel		
1967:								
Northern California	6	21,700	17,877	17,822	$61,109	$3.43	1,418	16,490
Southern California	8	40,600	24,178	24,212	76,852	3.17	1,744	21,701
Total	14	62,300	42,055	42,034	137,961	3.28	3,162	38,191
1968:								
Northern California	6	21,700	18,426	18,967	61,682	3.25	1,446	17,783
Southern California	8	42,600	28,650	28,628	90,279	3.15	1,780	26,848
Total	14	64,300	47,076	47,595	151,961	3.19	3,226	44,631

[1] Northern and Southern California are divided by the northern boundaries of San Luis Obispo and Kern Counties and the western boundaries of Inyo and Mono Counties.
[2] Includes receipts from other States. Excludes imports from foreign countries.

Table 10.—Source and destination of shipments of portland cement

(Thousand 376-pound barrels)

Destination	Source				Total	
	Northern California mills		Southern California mills			
	1967	1968	1967	1968	1967	1968
Northern California	14,139	15,725	1,806	1,141	15,945	16,866
Southern California	361	438	21,329	26,384	21,690	26,822
Nevada	154	114	592	727	746	841
Oregon	W	W	W	W	(1)	(2)
Arizona	------	--------	270	146	270	146
Other	[3] 3,168	[3] 2,690	[4] 215	[4] 230	3,383	2,920
Total	17,822	18,967	24,212	28,628	42,034	47,595
Building material dealers	1,188	1,005	2,063	1,730	3,251	2,735
Concrete product manufacturers	1,601	1,617	2,982	3,274	4,583	4,891
Ready-mixed concrete	11,876	12,207	14,857	18,376	26,733	30,583
Contractors and government agencies	3,032	3,958	4,096	4,717	7,128	8,675
Miscellaneous and own use	125	180	214	531	339	711
Total	17,822	18,967	24,212	28,628	42,034	47,595

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Included with "Other;" total 1,203,000 barrels shipped from northern and southern California to Oregon.
[2] Included with "Other;" total 1,239,825 barrels shipped from northern and southern California to Oregon.
[3] Includes Alaska, Colorado (1968), Hawaii (1968), Idaho (1967), Oregon, Utah, Washington, foreign countries, and U.S. Possessions and Territories.
[4] Includes Colorado, Hawaii, Idaho, Iowa, Kansas (1968), Louisiana (1967), Michigan, Missouri, Mississippi (1968), New Mexico, Ohio (1968), Oregon, Texas, Utah, Washington, Wyoming, and foreign countries.

Clays and Shale.—Total output (sold and used) of clays and shales increased 6 percent in quantity and 10 percent in value. Ball clay production declined sharply. Large increases were recorded in output of fire clay and miscellaneous clays and shales. Ball clay was mined at two properties in San Bernardino County and one in Stanislaus County; bentonite was produced at two mines in Inyo County, and one each in Imperial, San Benito, and San Bernardino Counties; fire clay and stoneware clay (19 percent of total clay output) were produced by 17 companies in seven counties, with Riverside County producing over half the total output of fire clay. Fullers' earth was produced in Inyo County; kaolin in Mono and Orange Counties; and miscellaneous clays and shales by 60 companies in 28 counties. Miscellaneous clays and shales accounted for 78 percent of total clay tonnage. Amador and Humboldt Counties became producers of miscellaneous clays; production was discontinued in Mariposa, Santa Clara, and Trinity Counties.

Diatomite.—Sales of crude and prepared diatomite declined in both quantity and value. Johns-Manville Products Corp., with extensive operations at Lompoc, Santa Barbara County, remained the Nation's dominant producer, offering a complete range of products. GREFCO, Inc., the second largest producer, operated its Dibble and Tolbert mine and mill, also in Santa Barbara County, making products chiefly for filtration, fillers, and insulation. Diatomic Chemical Co., with a mine and plant near Lompoc, produced material for absorbents, while Basalt Rock Co., Inc., Napa County, processed diatomaceous material for pozzolan. The Sicalite Company mine in Shasta County produced diatomite for lightweight aggregate and for use in swimming pool construction, and the producer reported he was planning to expand the operation in 1969.

Airox Co., with a mine and calcination plant near Santa Barbara, was the only firm to report sales of crude diatomite. Late in the year Pozzolan Products, Inc., purchased Airox Co.

The major use (62 percent) of diatomite was for filtration.

Feldspar.—The tonnage of marketable feldspar sold and used was 28 percent above that in 1967, and the value was 36 percent higher. Del Monte Properties Co. and Owens-Illinois Glass Co. mined and processed feldspathic dune sands of the Monterey Peninsula near Pacific Grove. Both companies removed heavy minerals from the sand, Del Monte by froth flotation and Owens-Illinois by magnetic separation. Owens-Illinois shipped its plant product to company glass plants. Del Monte sold sand to the glass industry and also produced feldspar and silica concentrates by flotation, and blended and ground them to customer specifications, principally for manufacturing sanitary ware and fiberglass.

Gypsum.—Production of crude gypsum increased to nearly 1.4 million tons in 1968 after a 2-year lag in demand for building product and agricultural uses. Crude gypsum for plaster and board product uses was mined in Imperial County. Agricultural gypsum was mined in Kern, Merced, San Bernardino, and San Luis Obispo Counties. Registered sales of agricultural gypsum in California were 1.2 million tons, including crude ore from out-of-State mines and byproduct gypsum from magnesia and phosphoric acid plants. Producers of portland cement in California consumed 378,000 tons of crude and byproduct gypsum in 1968.

Seven gypsum product plants produced 742,000 tons of calcined gypsum, utilizing ore from mines in California, Nevada, and Mexico. Principal products were base-coat plasters, ⅜-inch lath, and ½-inch and ⅝-inch wallboard, for which about 75 percent of the calcined gypsum was consumed.

Iodine.—No crude iodine was produced in California in 1968. However, Deepwater Chemical Co. operated a plant at Compton, Los Angeles County, on purchased foreign crude iodine, producing various iodates and iodides and some resublimed iodine.

Kyanite.—Quartz kyanite rock was mined at the Bluebird mine of Western Industrial Minerals, Imperial County, and by Western States Stone Co., Santa Clara County, for use in school kits and for dimension stone.

Lime.—Production of lime and dead-burned dolomite amounted to 568,000 tons, including nearly 461,000 tons for chemical and industrial uses. Large gains in the use of lime were for recovering magnesium compounds from seawater and for refining sugar. Other significant increases were in soil stabilization, ore concentration, tanning, and sewage treatment. Declines were reported for use in agriculture and in the manufacture of refractories, paper, and steel.

Producers used nearly 358,000 tons of lime in their own plants and sold 210,000 tons to California and out-of-State customers. California consumers received 242,000 tons of lime from out-of-State producers. Total consumption of primary lime in California was 777,000 tons, or 37,000 tons more than in 1967.

Inorganic Chemical Division, FMC Corp., discontinued calcining lime in August when it shut down its magnesia plant at Newark, Alameda County. The Sierra Lime Products Corp. lime plant at Cool, El Dorado County, was not operated during 1968. U.S. Lime Division, The Flintkote Co., expected to have its new lime hydrating facility at City of Industry, Los Angeles County, completed and on stream by the end of 1969.

Lithium Compounds.—American Potash & Chemical Corp., Division of Kerr-McGee Corp., produced lithium carbonate from Searles Lake brines in its San Bernardino County plant. Quantity and value were virtually unchanged from 1967 levels.

Magnesium Compounds.—Production, sales, and producer consumption of magnesium compounds were higher in 1968 despite the closing in August of the FMC Corp. magnesia plant in Newark, Alameda County. The FMC Corp. plant in San Diego continued to produce magnesia and magnesium chloride from salt-works bitterns. Kaiser Aluminum & Chemical Corp. recovered magnesia from seawater at its plant at Moss Landing, Monterey County. Kaiser consumed most of its output in the manufacture of refractories for the integrated steel plant of Kaiser Steel Corp., San Bernardino County. Merck & Co. produced magnesium carbonate, magnesium trisilicate, and magnesia at its San Mateo County plant.

Mica.—Rockton Mining & Manufacturing, Inc., mined mica (sericite schist) from its Bouquet Canyon mine near Saugus, Los Angeles County. The crude material was processed by Paramount Pacific, Inc., of Kern County, and sold for use in oil-well drilling muds. The Western Industrial Minerals property near Ogilby, Imperial County, was idle all year.

Perlite.—The American Perlite Co. Fish Springs quarry in Inyo County was again the only active perlite property. Production and sales of crude perlite increased slightly.

Nine perlite-expansion plants were operated: five in Los Angeles County, and one each in Contra Costa, Napa, San Diego, and Sonoma Counties. The raw material for some of the plants was crude perlite purchased outside the State. Although the tonnage of expanded perlite more than doubled, the average price dropped enough to cause a decline of 9 percent in the value of expanded perlite sold.

About 10 percent of the expanded output was used for concrete aggregate, 11 percent for soil conditioner, 14 percent for filter aids, and 65 percent for all other uses, including primarily building plaster and loose-fill insulation.

Phosphate Rock.—The State's first commercial phosphate producer, Cuyama Phosphate Corp., began mining and crushing a phosphatic rock from a deposit 60 miles southwest of Bakersfield, in Santa Barbara County. The material contained 5 percent phosphate and was used as a soil additive.

Potassium Salts.—American Potash & Chemical Corp., division of Kerr-McGee Corp., recovered potassium chloride from Searles Lake brines in San Bernardino County and converted part of its product to potassium sulfate. The total value of its chloride production declined nearly 6 percent.

Pumice.—Pumice, pumicite, and volcanic cinder production (sold or used) was 10 percent less in quantity and 3 percent less in value than in 1967. Only 20 percent of the output was prepared by crushing, screening, grinding, or other processing, but this accounted for 52 percent of the total value of the material sold or used. Production increases were reported for prepared pumice and for crude pumice used for cleansing compounds, concrete aggregate, ballast, and landscaping, but these were offset by a large decrease in pumice used for road construction. Output was reported from 44 mines.

Salt.—Salt production continued to rise and established a record high 10 percent above the 1967 quantity. Six major companies and one metropolitan water district produced crude salt by solar evaporation

Table 11.—Pumice[1] sold or used by producers in 1968, by counties

County	Crude		Prepared		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Butte	25,253	$12,626	---------	---------	25,253	$12,626
Inyo	---------	---------	W	W	W	W
Kern	64	192	W	W	64	192
Lake	18,298	18,298	W	W	18,298	18,298
Lassen	347,158	349,497	W	W	347,158	349,497
Madera	---------	---------	W	W	W	W
Modoc	47,519	47,519	5,078	$7,542	52,592	55,061
Mono	14	14	17,278	260,253	17,292	260,267
Napa	1,094	2,148	506	1,777	1,600	3,925
San Bernardino	20,040	18,036	184	1,671	20,174	19,707
Shasta	24,137	32,306	1,534	4,513	25,671	36,819
Siskiyou	132,585	141,617	W	W	132,585	141,617
Tehama	6,200	6,200	---------	---------	6,200	6,200
Undistributed	---------	---------	128,919	407,493	128,919	407,493
Total	622,312	628,453	153,444	683,249	775,756	1,311,702

W Withheld to avoid disclosing company confidential data; included with "Undistributed."
[1] Includes pumicite and volcanic cinder.

from 13 plants in seven counties. Most of the output came from seawater evaporating ponds in Alameda, Napa, and San Mateo Counties. Other counties reporting production were Kern, Orange, San Bernardino, and San Diego. No salt was produced in Monterey County. Leslie Salt Co. obtained solar, vacuum-pan, and pressed-block salt at its Alameda County plant and rock salt from its Amboy plant in San Bernardino County. Nearly half the total salt output went to consumers in California; significant quantities were exported to Japan and Canada and shipped to consumers in Arizona, Idaho, Montana, Nevada, New Hampshire, Oregon, Utah, Washington, and Alaska.

Sand and Gravel.—Production of sand and gravel rose to a record 124.7 million tons, as demand increased for its use in highway construction, the San Francisco Bay Area rapid-transit system, water resource facilities, and office and apartment buildings in metropolitan areas. Sand and gravel pits in Los Angeles County yielded 23.8 million tons, and more than 10 million tons each was produced in Alameda, Orange, and San Bernardino Counties.

Of the total production, 118 million tons was processed in stationary and portable plants and 7 million tons was used as pit-run material. Of the 375 operations in the State classified as commercial, 23 produced over 1 million tons each, 42 between 500,000 and 1 million tons each, 97 between 100,000 and 500,000 tons each, and 213 less than 100,000 tons each.

Production of special industrial sands increased appreciably above that in 1967, particularly for glass manufacture and sandblasting.

Sodium Compounds.—Sales of sodium compounds were slightly higher than in 1967. A decline in the value of sodium carbonate production was offset by an increase reported for sodium sulfate. PPG Industries, Inc., Inyo County's soda ash and sodium sesquicarbonate producer, ter-

Table 12.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Sand		Gravel		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	45,297	$53,309	67,698	$76,024	112,995	$129,333
1965	48,536	58,152	69,774	78,075	118,310	136,227
1966	48,930	57,144	71,762	82,013	120,692	139,157
1967	48,739	59,284	67,386	79,928	116,125	139,212
1968	50,726	64,158	73,929	89,202	124,655	153,360

Table 13.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Glass	W	W	W	W
Molding	63	$287	58	$272
Building	18,837	22,227	21,904	27,926
Paving	13,756	15,264	13,993	16,913
Blast	262	1,152	276	1,294
Engine	54	153	64	185
Filter	W	W	W	W
Other	7,373	10,613	5,775	9,601
Total	40,345	49,696	42,070	56,191
Gravel:				
Building	20,739	25,596	25,335	33,214
Paving	28,757	34,939	30,418	37,419
Railroad ballast	251	279	85	102
Other	5,602	6,672	2,587	2,915
Total	55,349	67,486	58,425	73,650
Total sand and gravel	95,694	117,182	100,495	129,841
Government-and-contractor operations: [1]				
Sand:				
Building	110	127	40	50
Paving	7,777	8,958	7,550	6,863
Fill	504	498	1,030	1,017
Other	3	5	36	37
Total	8,394	9,588	8,656	7,967
Gravel:				
Building	129	219	44	48
Paving	10,151	10,856	10,513	12,309
Fill	1,634	1,285	4,802	3,040
Other	123	132	145	155
Total	12,037	12,442	15,504	15,552
Total sand and gravel	20,431	22,030	24,160	23,519
All operations:				
Sand	48,739	59,284	50,726	64,158
Gravel	67,386	79,928	73,929	89,202
Total	116,125	139,212	124,655	153,360

W Withheld to avoid disclosing individual company confidential data; included with "Other."

[1] Includes figures for State, counties, municipalities, and other government agencies.

minated production in February. United States Borax & Chemical Corp., Kern County, shipped crude borates to its Wilmington refinery, Los Angeles County, where byproduct salt cake was produced. American Potash & Chemical Corp., Division of Kerr-McGee Corp., and Stauffer Chemical Co. each produced soda ash and salt cake from Searles Lake brines, San Bernardino County. Stauffer also produced glauber salt at its Searles Lake plant and recovered byproduct anhydrous sodium sulfate from purchased Kern County borates in its San Francisco facility.

Stone.—Total output of stone declined to 36.1 million tons from 37.2 million tons in 1967, as most of the paving and structural projects reached the stage where demand shifted from base materials to aggregate materials obtained from nearby producers of sand and gravel. Production of riprap and jetty stone also was less than in 1967. The only significant increase in stone output was for limestone, nearly 13 million tons of which was used in manufacturing portland cement.

Basalt, granite, marble, sandstone, quartz, quartzite, and other unclassified stone also were quarried in California for various construction uses. Oystershell was dredged from the San Francisco Bay and used as poultry grit and in making cement. Output

Table 14.—Sand and gravel production in 1968, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Alameda	11,585	$14,756
Butte	786	881
Calaveras	93	92
Colusa	251	264
Del Norte	244	272
El Dorado	133	177
Fresno	5,834	5,585
Glenn	290	306
Humboldt	454	590
Imperial	1,479	1,569
Inyo	270	394
Kern	5,135	7,400
Kings	454	464
Lake	358	469
Lassen	794	834
Los Angeles	23,792	29,601
Madera	810	719
Marin	555	382
Mariposa	79	134
Mendocino	368	574
Merced	1,147	1,374
Modoc	310	424
Mono	329	343
Monterey	1,055	2,159
Napa	56	74
Nevada	526	730
Orange	10,245	11,194
Placer	338	525
Plumas	134	$214
Riverside	3,077	4,917
Sacramento	5,529	7,538
San Benito	555	610
San Bernardino	10,596	10,731
San Diego	7,672	12,203
San Joaquin	2,826	3,881
San Luis Obispo	283	528
Santa Barbara	2,494	2,612
Santa Clara	2,873	2,603
Santa Cruz	1,734	2,439
Shasta	1,320	1,348
Sierra	1,168	1,168
Siskiyou	2,002	1,691
Solano	20	23
Sonoma	2,320	2,998
Stanislaus	1,117	1,425
Sutter	105	110
Tehama	331	390
Trinity	206	297
Tulare	1,281	1,382
Tuolumne	(1)	(1)
Ventura	4,796	4,428
Yolo	2,126	2,623
Other counties [2]	2,320	4,925
Total	124,655	153,360

[1] Less than ½ unit.
[2] Includes Amador, Contra Costa, San Francisco, San Mateo, and Yuba Counties.

Table 15.—Stone[1] production in 1968, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Alameda	1,759	$1,395
Amador	(2)	(2)
Butte	(2)	(2)
Calaveras	W	W
Colusa	20	20
Contra Costa	2,548	3,897
Del Norte	931	262
El Dorado	475	1,579
Fresno	257	172
Humboldt	576	641
Imperial	6	6
Inyo	169	858
Kern	2,927	3,302
Lake	1	2
Los Angeles	1,416	2,402
Madera	3	W
Marin	W	W
Mariposa	2	24
Mendocino	41	95
Modoc	13	16
Mono	6	1
Monterey	W	W
Napa	W	W
Nevada	15	7
Placer	W	W
Plumas	W	W
Riverside	1,288	$3,760
San Benito	W	W
San Bernardino	5,394	9,390
San Diego	1,867	3,595
San Luis Obispo	W	W
San Mateo	1,363	2,305
Santa Barbara	21	75
Santa Clara	5,954	4,443
Santa Cruz	1,408	1,974
Shasta	W	W
Sierra	66	66
Siskiyou	193	294
Solano	440	627
Sonoma	377	532
Tehama	1	1
Trinity	316	580
Tulare	351	176
Tuolumne	W	W
Ventura	98	W
Yuba	935	320
Other counties	4,888	9,854
Total	36,125	52,671

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes stone used in cement and lime.
[2] Less than ½ unit.

Table 16.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Quantity	Value	Quantity	Value	Quantity	Value
	Granite		Basalt and related rocks (traprock)		Limestone [1]	
1964	3,994	$5,479	2,282	$3,144	16,908	$23,582
1965	4,286	6,193	2,480	3,085	15,840	22,959
1966	4,862	5,855	2,218	3,202	16,130	23,890
1967	4,755	7,274	2,130	2,542	14,307	21,216
1968	4,052	6,296	1,471	1,840	16,904	24,548
	Sandstone		Other stone [2]		Total	
1964	3,065	$6,118	19,556	$25,243	45,805	$63,566
1965	4,061	7,202	15,908	20,279	42,575	59,668
1966	3,569	7,080	16,272	21,309	43,051	61,336
1967	3,663	6,563	12,331	17,668	37,186	55,263
1968	3,086	5,805	10,662	14,182	36,125	52,671

[1] Includes dolomite, limestone, and oystershell used in cement and lime as follows (in thousand short tons and thousand dollars): 1964, 13,657 tons, $14,226; 1965, 12,993 tons, $13,870; 1966, 12,771 tons, $14,000; 1967, 11,593 tons, $12,911; 1968, 13,356 tons, $15,209.

[2] Includes light-colored volcanics, schist, serpentine, river boulders, and such other stone as cannot properly be classed in any main group; also marble and slate.

of dimension stone increased substantially, mainly because a large tonnage of rubble was quarried and processed for use in construction of Bullards Bar Dam in Yuba County.

Sulfur.—Sulfur ore was produced and shipped by only one company, Magnaminerals, Inc., which worked the Crater deposit, Inyo County. The tonnage shipped was much higher than in 1967. Three companies in Contra Costa County, five in Los Angeles County, and one in San Luis Obispo County recovered elemental sulfur from sour natural gas and refinery gases by the Klaus process or a modification thereof. Production and shipments of elemental sulfur both rose significantly.

Talc, Soapstone, and Pyrophyllite.—Production of crude talc, soapstone, and pyrophyllite rose 15 percent to 165,000 short tons. Crude material shipped to grinders in and out of California rose 4 percent to 153,000 short tons. Crude material received by California grinders (from California and Nevada producers) rose from 137,000 short tons to 143,000 short tons. Sales value of ground talc, soapstone, and pyrophyllite from California grinders rose from $2,532,054 to $3,402,210. The ground material was used primarily for paint, ceramics, and insecticides. Talc was mined in Inyo and San Bernardino Counties; soapstone in Amador, El Dorado, and Los Angeles Counties; and pyrophyllite in Mono and San Diego Counties.

Grinding plants were operated in the following counties: Alameda (talc and soapstone), El Dorado (soapstone), Inyo (talc and soapstone), Sacramento (soapstone), San Bernardino (talc, soapstone, and pyrophyllite), and San Diego (pyrophyllite).

Wollastonite.—Wollastonite was mined from an open pit near Spanish Springs, Inyo County, by Interpace Corp. (formerly International Pipe and Ceramic Corp.) and near Blythe, Riverside County, by Chas. Pfizer & Co., Inc. Quantity and value increased substantially. The output was used in the manufacture of ceramic products.

Other Nonmetals.—Chas. Pfizer & Co., Inc., reported increases of 9 percent and 13 percent, respectively, for the quantity and value of iron oxide pigments produced and sold. Declines were reported only in the production of red oxides. The plant in Alameda County, which produced natural and manufactured iron oxide pigments, was the only such facility in the State. Basic raw materials for the natural products came from out-of-State sources.

Crude vermiculite, obtained from out-of-State, was exfoliated in plants in Alameda, Los Angeles, and Orange Counties. Increases were reported for all use categories—insulation, aggregate, and agriculture.

Mineral Wool Insulation Co. used blast-furnace slag to produce roofing granules, road paving, railroad ballast, and mineral wool, among other products, at its facility in Fontana, San Bernardino County.

In Antelope Valley, Kern County, Great Lakes Carbon Corp. operated furnaces to produce manufactured graphite for anodes, electrodes, and crucibles and other vessels. Production declined slightly.

Water.—In February, a combination of Magma Power Co., Thermal Power Co., and Union Oil Co. of California, announced that its first geothermal steam well of the 1968 season came in. The combine reported that the well in Sonoma County produced 218,000 pounds of superheated steam per hour, the equivalent of 10,900 kilowatts. The company had 14,500 acres under lease. The steam was sold to Pacific Gas & Electric Co. for the generation of electricity.

Geothermal Resources International, Inc., formed a joint venture with Systems Capital Corp. and Vanderbilt Corp. (both of Philadelphia, Pa.) to build a 300,000-kilowatt geothermal electrical power facility in the Geysers area, near Santa Rosa, Sonoma County. The Bureau of Reclamation was authorized to negotiate with Geothermal Resources International, Inc., for the purchase of power generated by geothermal steam.

Cordero Mining Co., Palo Alto, Calif., a subsidiary of Sun Oil Co., entered into a joint venture with D. D. Feldman of Dallas and Los Angeles to explore for geothermal steam in the Clear Lake area of northern California.

The Federal Water Pollution Control Administration awarded $17,728,873 in planning and construction grants and contracts. Planning grants went to the California State Water Resource Control Board (San Francisco Bay-Delta Water Quality Control Program—$122,000) and to the Santa Ana Watershed Planning Agency ($110,000). Of the construction grants, which totaled $17,496,873, the largest recipients were the City of Richmond, $1,700,840; Chino Basin Municipal Water District, $1,650,580; County Sanitation District No. 1, Orange County, $3,374,500; and Central Sanitation District, Sacramento County, $1,037,850.

The Bolsa Island nuclear desalting project was terminated on December 31, 1968, amid reaffirmations that nuclear desalting holds great promise for solving the water problems of Southern California. The project involved the Office of Saline Water, U.S. Department of the Interior; the Atomic Energy Commission; and the Metropolitan Water District of Southern California and originally called for a dual purpose water-desalinization and power-generation plant to be built on a man-made island offshore from the Bolsa Chica State Beach. However, increasing costs of labor and materials projected to the completion of the project forced reconsideration of the offshore island concept. The entire project was terminated when an alternative site could not be agreed upon.

METALS

Antimony.—A small quantity of antimony was mined by Abaca Mining Co. in Kern County.

Copper.—Almost all copper was produced as a byproduct in the treatment of other ores. Output increased 50 percent in quantity and 64 percent in value. The Pine Creek tungsten mine, Inyo County, of Union Carbide Corp. was the principal producer.

Gold.—Lode gold production increased 63 percent, but because of the drop in placer gold output after October 1, when the last dredge of Yuba Consolidated Industries, Inc., was shut down, gold production was only 39 percent of the 1967 figure. Four lode mines produced over 100 ounces of gold each: Zaca gold-silver mine, Alpine County; Darwin lead-zinc mine, Inyo County; Pine Creek tungsten mine, Inyo County; and Oriental gold mine, Sierra County. Seven companies produced over 100 ounces of gold each by placer methods. Two of the placer companies were in Fresno County, two in Sacramento County, and one each in San Joaquin County, Sierra County, and Yuba County. Five of these were sand and gravel companies, which produced the gold as a byproduct in washing streambed gravels for aggregate.

Iron Ore.—Production and shipments of usable iron ore increased 7 and 3 percent, respectively, in quantity. The Kaiser Steel Corp. Eagle Mountain mine, Riverside County, continued as the State's principal iron ore source. Pellets from Kaiser's plant at Eagle Mountain constituted nearly 40 percent of all shipments. Exports of concentrates and agglomerates (all from Eagle

Table 17.—Mine production of gold, silver, copper, lead and zinc in 1968, by counties, in terms of recoverable metals

County	Mines producing [1]		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
Fresno	--------	(2)	654	$26	96	(3)
Inyo	6	--------	699	27	563,523	$1,209
Mariposa	2	(2)	67	3	10	(3)
Merced	--------	(2)	28	1	27	(3)
Nevada	--------	1	59	2	3	(3)
Plumas	1	2	137	5	571	1
San Benito	1	(2)	--------	--------	580	1
San Diego	1	(2)	2	(3)	1	(3)
San Joaquin	1	(2)	867	34	85	(3)
Sierra	3	1	1,708	67	365	1
Tuolumne	1	1	17	1	--------	--------
Yuba	--------	1	9,971	391	--------	--------
Undistributed [4]	18	5	1,473	58	32,750	70
Total [5]	34	11	15,682	616	597,961	1,282

County	Copper		Lead		Zinc		Total value (thousands)
	Thousand pounds	Value (thousands)	Thousand pounds	Value (thousands)	Thousand pounds	Value (thousands)	
Fresno	------	------	------	------	------	------	$26
Inyo	2,818	$970	7,642	$1,010	7,013	$947	4,162
Mariposa	------	------	------	------	------	------	3
Merced	------	------	------	------	------	------	1
Nevada	------	------	------	------	------	------	2
Plumas	14	6	------	------	------	------	12
San Benito	------	------	------	------	------	------	1
San Diego	------	------	------	------	------	------	(3)
San Joaquin	------	------	------	------	------	------	34
Sierra	------	------	------	------	------	------	68
Tuolumne	------	------	------	------	------	------	1
Yuba	------	------	------	------	------	------	391
Undistributed [4]	32	14	360	48	37	5	194
Total [5]	2,864	989	8,002	1,057	7,050	952	4,896

[1] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.
[2] From property not classed as a mine.
[3] Less than ½ unit.
[4] Includes Alpine, Amador, Butte, El Dorado, Imperial, Kern, Los Angeles, Mono, Placer, Sacramento, San Bernardino, Santa Clara, Shasta, Siskiyou, and Trinity Counties.
[5] Data may not add to totals shown because of independent rounding.

Mountain) declined. Pacific Western Industries, Kern County, produced ore for use in its cement plant. American Exploration & Mining Co. produced and shipped concentrate from its Iron Age mine in San Bernardino County to domestic cement, pig iron, and steel producers. The Kaiser Steel Corp. Silver Lake mine was idle, and no shipments were made from stockpile.

Lead.—Production of lead more than doubled in quantity and value, primarily because of increases in output at the Darwin, Jubilee, and Santa Rosa mines, all in Inyo County. The increases were partly due to settlement of the copper strike which had shut down smelters from July 1967 through March 1968.

Mercury.—Expanded activity at the State's leading mercury mine, the New Idria, in San Benito County, was an important factor in the increase of 5,032 flasks over total California production in 1967. Although overall output rose 31 percent, shipments were only 24 percent higher, resulting in an increase in stocks. Of 53 mines and prospects active, 25 fewer than in 1967, 17 yielded over 100 flasks of mercury each, and of these, seven produced over 1,000 flasks each. Mines producing over 100 flasks accounted for 97 percent of total production, compared with 96 percent in 1967. The four leading producers supplied nearly two-thirds of total production: New Idria Mining & Chemical

Table 18.—Gold produced at placer mines, by classes of mines and methods of recovery

Class and method	Mines producing [1]	Number of washing plants (dredges)	Material treated (thousand cubic yards)	Gold recovered: Troy ounces	Gold recovered: Value (thousands)	Gold recovered: Average value per cubic yard
Surface placers:						
Gravel mechanically handled:						
Bucketline dredges:						
1964	1	3	11,611	62,422	$2,185	$0.188
1965	1	3	12,412	53,987	1,888	.152
1966	1	3	12,102	58,863	2,060	.170
1967	1	1	4,348	35,819	1,254	.288
1968	1	1	3,034	9,954	391	.129
Dragline dredges: [2]						
1964	1	1	132	545	19	.145
1965	2	2	540	1,096	38	.071
1966	3	3	191	1,314	46	.241
1967	2	2	54	150	5	.097
1968	--------	--------	--------	----------	----------	---------
Suction dredges:						
1964	3	3	1	112	4	3.439
1965	1	1	(3)	8	(3)	.560
1966	2	2	10	52	2	.182
1967	3	3	(3)	15	1	.633
1968	3	3	3	204	8	2.592
Nonfloating washing plants: [2] [4]						
1964	2	18	5	1,203	42	.381
1965	1	16	(3)	1,047	37	3.500
1966	1	19	(3)	2,028	71	.514
1967	1	18	180	2,394	84	.466
1968	1	12	128	2,569	101	.785
Gravel hydraulically handled:						
1964	1	--------	2	73	3	1.278
1965	--------	--------	--------	----------	----------	---------
1966	--------	--------	--------	----------	----------	---------
1967	--------	--------	--------	----------	----------	---------
1968	--------	--------	--------	----------	----------	---------
Small-scale hand method: [5]						
1964	30	--------	54	1,420	50	.918
1965	21	--------	24	2,476	87	3.617
1966	16	--------	27	851	30	1.110
1967	17	--------	18	615	22	1.196
1968	5	--------	4	356	14	3.547
Underground placers: Drift:						
1964	1	--------	16	163	6	.352
1965	1	--------	(3)	7	(3)	4.900
1966	2	--------	(3)	13	(3)	7.583
1967	1	--------	(3)	15	1	5.250
1968	1	--------	1	60	2	3.927
Grand total placers: [6]						
1964	39	--------	11,821	65,938	2,308	.195
1965	27	--------	12,976	58,571	2,050	.158
1966	25	--------	12,330	63,121	2,209	.179
1967	25	--------	4,601	39,008	1,365	.297
1968	11	--------	3,170	13,143	516	.163
1848–1968	--------	--------	NA	68,466,334	1,532,115	NA

NA Not available.

[1] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.

[2] Includes commercial rock plants and tungsten mines that produced byproduct gold from gravels; byproduct gold is included with gold recovered, but material treated and average value per cubic yard refer only to straight gold dredging.

[3] Less than ½ unit.

[4] Includes all placer operations using power excavator and washing plants both on dry land; when the washing plant is a movable outfit, it is termed "dryland dredge."

[5] Includes all operations in which hand labor is the principal factor in delivering gravel to sluices and long toms.

[6] Data may not add to totals shown because of independent rounding.

Table 19.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals[1]

Year	Mines producing[2] Lode	Mines producing[2] Placer	Material sold or treated[3] (thousand short tons)	Gold (lode and placer) Troy ounces	Gold (lode and placer) Value (thousands)	Silver (lode and placer) Troy ounces	Silver (lode and placer) Value (thousands)
1964	43	39	16	71,028	$2,486	171,621	$222
1965	51	27	20	62,885	2,201	196,787	254
1966	52	25	25	64,764	2,267	189,989	246
1967	29	25	15	40,570	1,420	144,515	224
1968	34	11	76	15,682	616	597,961	1,282
1848–1968	NA	NA	NA	106,250,359	2,420,938	120,607,637	99,505

Year	Copper Short tons	Copper Value (thousands)	Lead Short tons	Lead Value (thousands)	Zinc Short tons	Zinc Value (thousands)	Total value (thousands)
1964	1,035	$675	1,546	$405	143	$39	$3,827
1965	1,165	825	1,810	565	225	66	3,911
1966	1,078	780	1,976	597	335	97	3,987
1967	788	602	1,735	486	441	122	2,854
1968	1,182	989	4,001	1,057	3,525	952	4,896
1848–1968	646,096	213,539	275,767	55,734	155,345	36,845	2,826,556

NA Not available.

[1] Includes recoverable metal content of gravel washed (placer operations); ore milled; old tailings or slimes retreated; tungsten ore; and ore, old tailings, slag, flue dust, and pyritic ore residue shipped to smelters during calendar year indicated.

[2] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.

[3] Does not include gravel washed.

Table 20.—Mine production of gold, silver, copper, lead, and zinc in 1968, by types of material processed and methods of recovery, in terms of recoverable metals[1]

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Amalgamation and cyanidation: Ore	873	838	---------	---------	---------
Concentration and smelting of concentrates: Ore[2]	1,016	500,757	2,303	4,450	6,554
Direct smelting: Ore	650	96,045	61	3,552	496
Placer	13,143	321	---------	---------	---------
Total	15,682	597,961	2,364	8,002	7,050

[1] Includes gold recovered as "natural gold."

[2] Includes tungsten-ore concentrate.

Co., San Benito County; Buena Vista Mines, Inc., San Luis Obispo County; El Capitan Mining Co., Inyo County; and Sonoma Mines, Inc. (name changed from Sonoma International, Inc., in late 1968), Sonoma County. Companies with furnace operations alone totaled 11, retort operations 38, and combination furnace and retort operations four. A few flasks of mercury were recovered by reworking tailings or mine dumps in Lake, Napa, and San Benito Counties and from a gold placer operation in Trinity County. Producing properties of record were distributed as follows, by counties: San Luis Obispo, nine; Lake, eight; San Benito, six; Sonoma, six; Fresno, two; Marin, four; Napa, three; Santa Clara, three; Kings, three; Santa Barbara, two; Trinity, two; Colusa, one; Contra Costa, one; Inyo, one; Mendocino, one; and Yolo, one.

Table 21.—Mine production of gold, silver, copper, lead, and zinc in 1968, by classes of ore or other source materials in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode ore:							
Gold	15	3,265	1,574	530	--------	--------	--------
Gold-silver	2	3,075	152	21,673	(2)	2	1
Silver	4	271	56	8,017	2	1	(2)
Copper and tungsten ore	5	[3] 119	185	69,379	2,162	--------	--------
Lead	6	6,361	79	86,108	26	3,541	498
Lead-zinc	1	63,297	498	411,654	174	4,457	6,548
Zinc	1	12	--------	279	--------	1	2
Total	34	76,400	2,539	597,640	2,364	8,002	7,050
Placer	11	(4)	13,143	321	--------	--------	--------
Total all sources	45	76,400	15,682	597,961	2,364	8,002	7,050

[1] Detail does not necessarily add to total, because some mines produce more than 1 class of material.

[2] Less than ½ unit.

[3] Tungsten ore tonnage not included.

[4] 3,038,544 cubic yards. Does not include material washed at commercial gravel plants to produce 2,568 ounces of byproduct gold and 318 ounces of byproduct silver included in placer totals.

El Capitan's relatively new operation in the Last Chance Mountains of Inyo County, north of Scotty's Castle, Death Valley, became a major producer during 1968. A sizable tonnage of rich ore was mined by open-pit methods and trucked several hundred miles for processing in a plant near Keene in Kern County. Shafts were excavated, and late in the year a change to underground mining was in progress.

New Idria Mining & Chemical purchased the New Almaden properties, optioned or leased part of the Guadalupe holdings in the same area of Santa Clara County, and began to explore and reopen sections of extensive old workings for development. The New Almaden, active only on a limited scale in recent years, was once the State's largest producer and has produced over 1 million flasks. Mill and furnace facilities were to be expanded in 1969. Also the company planned extensive exploration at its New Idria mine with assistance from the U.S. Geological Survey's Office of Minerals Exploration.

Sunbird Mines, Inc., with its Gibraltar (or Sunbird) open-pit deposit in Santa Barbara County, rose to the rank of producers of 1,000 flasks or more, and the Altoona mine of Altoona Mine, Inc., Trinity County, became a producer of over 500 flasks. At the Juniper mine, San Benito County, Cal-Merc Mining Co. de-

Table 22.—Mercury production, by method of recovery

Year	Operating mines	Recovery method					Total	
		Furnaced [1]		Retorted		Unclassified (76-pound flasks) [2]		
		Ore treated (short tons)	76-pound flasks	Ore treated (short tons)	76-pound flasks		76-pound flasks	Value [3]
1964	39	89,630	8,949	12,595	1,334	8	10,291	$3,239,504
1965	84	137,079	11,219	21,060	2,168	17	13,404	7,650,333
1966	72	136,698	13,714	16,292	2,344	12	16,070	7,100,047
1967	78	184,656	13,942	67,895	2,438	5	16,385	8,018,164
1968	53	176,502	19,494	38,959	1,918	5	21,417	11,470,089

[1] Includes ore and mercury from dumps not separable.

[2] Includes mercury recovered from miscellaneous dump material, placer, and cleanup operations.

[3] Value calculated at average New York price.

veloped a sizable ore reserve and was installing a 75-ton-per-day rotary kiln, due for startup in March 1969. Mt. Konocti Mining Co.'s furnace plant burned in the latter part of 1968. Buttes Gas and Oil Co. operated a new 75-ton rotary kiln at its Gambonini property in Marin County, and ore discoveries were reported near Petaluma at the Red Jacket mine, where a small treatment plant was in operation. A furnace in Aurora Canyon, near Bridgeport, Mono County, was reported to have been moved into Nevada to serve other mercury sources. Exploration was carried on at the Oat Hill mine, once a large producer in Napa County, and geophysical exploration was conducted at the Reed mine in Yolo County. A new rotary kiln operated at the Knoxville mine, Napa County, where development beneath an existing open pit was being considered. In the same area, a mill was installed at the Harrison mine and exploration proceeded at the Manhattan mine.

Molybdenum.—Union Carbide Corp. recovered molybdenite and powellite as byproducts in the treatment of tungsten ores at its Pine Creek mine, Inyo County. Production of molybdenite increased, but shipments of both byproducts were very much lower. All shipments were consigned to domestic customers.

Pig Iron, Sinter, and Ferrous Scrap.—Kaiser Steel Corp. produced all the State's pig iron at its Fontana blast furnace, San Bernardino County. The furnace consumed 6 percent more concentrate and 3 percent less sinter, in producing 3 percent more pig iron. The output was 94 percent basic pig iron and 6 percent direct castings. Kaiser Steel furnaces consumed 10 percent less ore (concentrate), 4 percent more pig iron (hot metal), and 4 percent more scrap (home and purchased and slag scrap) than in 1967. The other large steel producer, United States Steel Corp. at Torrance, Los Angeles County, used pig iron and scrap.

Platinum.—Byproduct platinum-group metals were recovered from stream and ancient riverbed gravels in the Hammonton area, Yuba County. Production of these metals in California ceased on October 1, when the gold dredge, Old Yuba 21, was shut down.

Rare-Earth Minerals.—Molybdenum Corporation of America (Molycorp) stated in its annual report that 22.8 million pounds of rare-earth oxides was contained in bastnaesite concentrates produced in its Mountain Pass, Calif., mine and mill. The decline from the reported 1967 high of 25.5 million pounds was attributed to a leveling off of the exceptionally rapid growth of rare-earth consumption. Although production was slightly lower than in 1967, sales rose 4 percent.

Silver.—Inyo County accounted for 94 percent of the total State silver output. The largest producers were Darwin (primarily a lead-zinc mine), Jubilee (lead), Pine Creek (tungsten), and Santa Rosa (lead). These mines, and the Zaca (gold-silver) mine in Alpine County, all increased their output and were responsible for a fourfold increase in the ounces of silver produced.

Tin.—No tin was produced in 1968.

Tungsten.—Pine Creek mine, Inyo County, of Union Carbide Corp. continued to produce a high percentage of the State's tungsten ore and concentrate. Union Carbide also purchased concentrates from producers or former producers in California, Arizona, Idaho, Montana, Nevada, New York, Pennsylvania, and Utah, and from the Government stockpile. Part of the produced and purchased concentrates were converted to paratungstate at the Pine Creek plant, and both concentrates and paratungstate were shipped to customers in other States.

New Idria Mining & Chemical Co., Madera County, and Mines Exploration, Inc., San Bernardino County, were the only other sizable producers of the 28 companies that reported production of tungsten ore or concentrate.

The average price for tungsten concentrate increased $1.57 per short ton unit.

Zinc.—Production of zinc increased almost eightfold in value and quantity, primarily because of expanded output from the Darwin mine, Inyo County. Production also increased several fold at the Santa Rosa mine, Inyo County, the second largest zinc producer.

Table 23.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Atlas Asbestos Co.	P.O. Box 805 Coalinga, Calif. 93210	Open-pit mine	Fresno.
Coalinga Asbestos Co.	P.O. Box 1045 Coalinga, Calif. 93210	do	Do.
Pacific Asbestos Corp.	P.O. Box 127 Copperopolis, Calif. 95228	do	Calaveras.
Union Carbide Corp.	P.O. Box K King City, Calif. 93930	do	San Benito.
Barite:			
L. G. Embree	P.O. Box 217 Wofford Heights, Calif. 93285	do	Tulare.
Yuba Minerals & Milling Co.	1615 Bonanza St. Walnut Creek, Calif. 95496	do	Shasta.
Boron minerals and compounds:			
American Potash & Chemical Corp.	P.O. Box 2294 Terminal Annex Los Angeles, Calif. 90054	Dry lake brines	San Bernardino.
Stauffer Chemical Co.	636 California St. San Francisco, Calif. 94119	do	Do.
United States Borax & Chemical Corp.	3075 Wilshire Blvd. Los Angeles, Calif. 90005	Open-pit mine	Inyo, Kern.
Bromine and bromine compounds:			
American Potash & Chemical Corp.	P.O. Box 2294 Terminal Annex Los Angeles, Calif. 90054	Dry lake brines	San Bernardino.
FMC Corp.	P.O. Box 344 Newark, Calif. 94560	Chemical plant	Alameda.
Calcium chloride:			
Chloride Products Co., Inc.	1221 West Workman Ave. West Covina, Calif. 91790	Dry lake brines	Imperial.
Imperial Thermal Products, Inc.	P.O. Box DD Calipatria, Calif. 92233	do	Do.
Leslie Salt Co.	P.O. Box 364 Newark, Calif. 94560	do	San Bernardino.
National Chloride Company of America.	615 South Flower St. Los Angeles, Calif. 90017	do	Do.
Carbon dioxide:			
Getty Oil Co.	P.O. Box 2955 Terminal Annex Los Angeles, Calif. 90054	Natural gasoline processing plant.	Kern.
Standard Oil Co.	225 Bush St San Francisco, Calif. 94120	do	Do.
Cement:			
American Cement Corp.	2404 Wilshire Blvd. Los Angeles, Calif. 90057	Dry process portland cement plants.	Riverside, San Bernardino.
Calaveras Cement Co.	315 Montgomery St. San Francisco, Calif. 94104	Wet and dry process portland cement plants.	Calaveras, Shasta.
California Portland Cement Co.	612 South Flower St. Mobil Bldg. Los Angeles, Calif. 90017	Dry process portland cement plants.	Kern, San Bernardino.
Ideal Cement Co.	620 Denver National Bldg. Denver, Colorado 80202	Wet process portland cement plants.	San Benito, San Mateo.
Kaiser Cement & Gypsum Corp.	Permanente Road Permanente, Calif. 95014	do	San Bernardino, Santa Clara.
Monolith Portland Cement Co.	Box 65677 Glassell Station Los Angeles, Calif. 90065	do	Kern.
Pacific Cement & Aggregates Division, Lone Star Cement Corp.	400 Alabama St. San Francisco, Calif. 94110	Dry process portland cement plant.	Santa Cruz.
Pacific Western Industries, Inc.	3810 Wilshire Blvd. Los Angeles, Calif. 90005	do	Kern.
Southwestern Portland Cement Co.	1034 Wilshire Blvd. Los Angeles, Calif. 90017	Wet and dry process portland cement plant.	San Bernardino.
Clays:			
American Cement Corp.	P.O. Box 832 Riverside, Calif. 92501	Open pit mine	Orange, Riverside, San Bernardino.
Atkinson Brick Co.	18633 South Central Ave. Los Angeles, Calif. 90059	do	Los Angeles.
Basalt Rock Co., Inc.	8th & River Sts. Napa, Calif. 94458	do	Napa.
Calaveras Cement Division, The Flintkote Co.	San Andreas, Calif. 95249	do	Amador, Calaveras, Shasta.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays—Continued			
California Non-Metallics.	P.O. Box 328 Trabuco Canyon, Calif. 92678	Open pit mine	Orange.
Crestlite, Inc., Division of Susquehanna-Western, Inc.	Camino De Estrella San Clemente, Calif. 92672	do	Do.
Davidson Brick Co.	4701 East Floral Ave. Los Angeles, Calif. 90022	do	Los Angeles.
Excel Mineral Co.	3451 East 26th St. Los Angeles, Calif. 90023	do	Kern.
Ideal Cement Co.	620 Ideal Cement Bldg. Denver, Colorado 80202	do	San Mateo, Santa Cruz.
International Pipe & Ceramics Corp.	2901 Los Feliz Blvd. Los Angeles, Calif. 90039	do	Amador, Placer, Riverside, San Bernardino, Sutter, Yuba.
Kaiser Industries Corp.	300 Lakeside Drive Oakland, Calif. 94612	do	Alameda.
Lincoln Clay Products Co.	P.O. Box 367 Lincoln, Calif. 95648	do	Placer.
Los Angeles Brick & Clay Products Co.	1255 West 4th St. Los Angeles, Calif. 90017	do	Riverside.
Richard Malugani	4611 Porter Creek Road Santa Rosa, Calif. 95404	do	Sonoma.
L. P. McNear Brick Co	P.O. Box 1380 San Rafael, Calif. 94902	do	Marin.
Mission Valley Brick Co.	P.O. Box 3217 San Diego, Calif. 92103	do	San Diego.
H. C. Muddox Co.	4875 Bradshaw Road Sacramento, Calif. 95826	do	Amador.
National Lead Co.	P.O. Box 1675 Houston, Tex. 77001	do	San Bernardino.
Pacific Cement & Aggregates.	400 Alabama St. San Francisco, Calif. 94110	do	Santa Cruz.
Pacific Clay Products Co.	1255 West 4th St. Los Angeles, Calif. 90017	do	Amador, Orange, Placer, Riverside, San Joaquin.
Chas. Pfizer & Co., Inc.	P.O. Drawer AD Victorville, Calif. 92394	do	Inyo, San Bernardino.
Port Costa Products Co.	P.O. Box 5 Port Costa, Calif. 94569	do	Contra Costa.
Ridgelite Products	650 South Grand Ave. Los Angeles, Calif. 90017	do	San Bernardino, Ventura.
Rocklite Products, Inc.	650 South Grand Ave. Los Angeles, Calif. 90017	do	Ventura.
W. A. Schoeppe Clay Co.	Box 101 El Toro, Calif. 92630	do	Orange.
Standard Industrial Minerals.	Route 4, Box 1 Bishop, Calif. 93514	do	Mono.
Coal (lignite):			
American Lignite Products Co., Inc.	P.O. Box 787 Ione, Calif. 95640	Strip mine	Amador.
Copper:			
Union Carbide Corp., Mining & Metals Division.	270 Park Ave., 38th Floor New York, N.Y. 10017	Underground mine	Inyo.
West Hill Exploration, Inc., T.A.C. Darwin Mines Dept.	Lone Pine, Calif. 93545	do	Do.
Diatomite:			
GREFCO, Inc.	630 Shatto Place Los Angeles, Calif. 90005	Open-pit mine	Santa Barbara.
Johns-Manville Products Corp.	Lompoc, Calif. 93436	do	Do.
Feldspar:			
Del Monte Properties Co.	P.O. Box 150 Pacific Grove, Calif. 93950	do	Monterey.
Owens-Illinois Glass Co.	P.O. Box 1035–1036 Toledo, Ohio 43601	do	Do.
Gold:			
Dickey Exploration Co.	Alleghany, Calif. 95901	Underground mine	Sierra.
Sacramento Gold Recovery Co.	4528 Shady Oak Fair Oaks, Calif. 95628	Byproduct of sand and gravel operation.	Sacramento.
Fred Santoni	5078 West Shields Ave. Fresno, Calif. 93705	do	Fresno, Merced, Sacramento, San Joaquin.
West Hill Exploration, Inc., T.A.C. Mines Dept.	Lone Pine, Calif. 93545	Underground mine	Inyo.
Yuba Consolidated Industries, Inc.	Star Route Marysville, Calif. 95901	Dredging	Yuba.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Gypsum:			
C. L. Fannin Agricultural Gypsum.	Route 1, Box 7, Famosa Hwy. Wasco, Calif. 93280	Open-pit mine	Kern.
H. M. Holloway, Inc.	714 Sixth St. Wasco, Calif. 93280	do	Do.
Monolith Portland Cement Co.	Box 65677 Glassell Station Los Angeles, Calif. 90065	do	Ventura.
Superior Gypsum Co.	2150 Franklin St. Oakland, Calif. 94612	do	Kern, San Luis Obispo.
Temblor Gypsum Co.	Carrisa Plains, Star Route Box 80 Santa Margarita, Calif. 93453	do	Kern.
United States Gypsum Co.	101 South Wacker Drive Chicago, Ill. 60606	do	Imperial.
Iron ore:			
American Exploration & Mining Co.	Twentynine Palms, Calif. 92277	do	San Bernardino.
Kaiser Steel Corp.	P.O. Box 158 Eagle Mountain, Calif. 92241	do	Riverside.
Lead:			
Paul Bare	P.O. Box 538 Lone Pine, Calif. 93545	Underground	Inyo.
Monte Cristo Mining Corp.	P.O. Box 218 Las Vegas, Nev. 89101	Underground mine	Inyo.
West Hill Exploration, Inc., T.A.C. Mines Dept.	Lone Pine, Calif. 93545	do	Do.
Lime:			
American Crystal Sugar Co.	Box 419 Denver, Colo. 80201	Shaft kiln	Yolo.
Diamond Springs Lime Co.	P.O. Box 407 Diamond Springs, Calif. 95619	Rotary kiln and continuous hydrator	El Dorado.
The Flintkote Co.	P.O. Box 57367 Flint Station Los Angeles, Calif. 90057	Shaft and rotary kilns, continuous hydrator.	Contra Costa, Tuolumne.
FMC Corp	P.O. Box 344 Newark, Calif. 94560	Rotary kiln	Alameda.
Holly Sugar Corp.	Box 1052 Colorado Springs, Colo. 80901	Shaft kilns and continuous hydrators.	Glenn, Imperial, Orange, San Joaquin.
Kaiser Aluminum & Chemical Corp.	Moss Landing, Calif. 95039	Rotary kiln and continuous hydrator.	Monterey.
Chas. Pfizer & Co., Inc.	P.O. Drawer AD Victorville, Calif. 92392	Fluidized-bed kiln and continuous hydrator.	San Bernardino.
Spreckels Sugar Co.	2 Pine St. San Francisco, Calif. 94111	Shaft and rotary kilns.	Monterey, San Joaquin, Yolo.
Stauffer Chemical Co.	636 California St. San Francisco, Calif. 94119	Rotary kiln and continuous hydrator.	San Bernardino.
Union Sugar Division	230 California St. San Francisco, Calif. 94111	Shaft kiln	Santa Barbara.
Lithium minerals:			
American Potash & Chemical Corp.	P.O. Box 2294 Terminal Annex Los Angeles, Calif. 90054	Dry lake brines	San Bernardino.
Magnesium compounds:			
FMC Corp	P.O. Box 344 Newark, Calif. 94560	Salt works bitterns	Alameda, San Diego.
Kaiser Aluminum & Chemical Corp.	Moss Landing, Calif. 95039	Seawater processing	Monterey.
Merck & Co., Inc.	Rahway, N.J. 07065	do	San Mateo.
Mercury:			
Altoona Mine, Inc.	P.O. Box 226 Guerneville, Calif. 95446	Underground mine	Trinity.
Buena Vista Mines, Inc.	P.O. Box 758 Paso Robles, Calif. 93446	do	San Luis Obispo.
Buttes Gas and Oil Co.	2150 Franklin St. Oakland, Calif. 94612	Open-pit mine	Marin.
El Capitan Mining Co.	Route 4, Box 7L Bishop, Calif. 93514	do	Inyo.
Guadalupe Mining Co.	14900 Guadalupe Mine Road San Jose, Calif. 95120	do	Santa Clara.
International Resources, Inc.	2225 Hillside Drive Santa Rosa, Calif. 95404	Underground mine	Lake.
L. W. Knepper	Idria, Calif. 95027	Open-pit mine	Fresno, San Benito.
Knoxville Exploration & Mining.	Box 2655 San Francisco, Calif. 94126	do	Napa.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Mercury—Continued			
Mt. Konocti Mining Co.	P.O. Box 566 Kelseyville, Calif. 95451	Open pit mine	Lake.
New Idria Mining & Chemical Co.	Idria, Calif. 95027	Underground and open-pit mines.	San Benito, Santa Clara.
Sonoma Mines, Inc	P.O. Box 226 Guerneville, Calif. 95446	Underground mine	Sonoma.
Sulphur Creek Mining	202 Ridge Road Ukiah, Calif. 95482	do	Do.
Sunbird Mines, Ltd	1018-A Anacapa St. Santa Barbara, Calif. 93101	Open-pit mine	Santa Barbara.
Vallejo Quicksilver	5741 Florin-Perkins Road Sacramento, Calif. 95828	Underground mine	Napa.
Mica:			
Rockton Mining & Manufacturing, Inc.	4760 Valley Blvd. Los Angeles, Calif. 90032	Open-pit mine	Los Angeles.
Molybdenum:			
Union Carbide Corp., Mining & Metals Division.	270 Park Ave., 38th Floor New York, N.Y. 10017	Underground mine	Inyo.
Natural gas:			
Amerada Petroleum Corp.	550 South Flower St. Los Angeles, Calif. 90017	Gasfield	Contra Costa, Sacramento, San Joaquin, Solano.
Atlantic Oil Co	523 West 6th St., Rm. 116 Los Angeles, Calif. 90014	do	Colusa, Glenn, Sutter, Yolo.
Buttes Gas & Oil Co	2150 Franklin St. Oakland, Calif. 94612	do	Butte, Colusa, Glenn, Sutter, Tehama.
Cameron Oil Co	110 Kermac Bldg. Oklahoma City, Okla. 73102	do	Colusa, Sutter.
Great Basins Petroleum Co.	1011 Gateway West Century City, Los Angeles, Calif. 90067	do	Colusa, San Joaquin.
Superior Oil Co	Box 1031 Bakersfield, Calif. 93302	do	Butte, Glenn, Kern, Sacramento, Solano, Tehama.
Transco Oil Co	500 South Main St., Suite 920 Orange, Calif. 92668	do	Kings.
Natural gas liquids:			
Atlantic Richfield Co	445 South Figueroa St. Los Angeles, Calif. 90054	Natural gasoline plants.	Kern, San Luis Obispo, Santa Barbara, Ventura.
Getty Oil Co	4201 Wilshire Blvd. Los Angeles, Calif. 90005	do	Kern, Ventura.
Mobil Oil Co	P.O. Box 2122 Terminal Annex Los Angeles, Calif. 90054	do	Fresno, Los Angeles.
Shell Oil Co	1008 West 6th Street Los Angeles, Calif. 90054	do	Kern, Los Angeles, Orange, Santa Barbara, Ventura.
Standard Oil Co. of California.	225 Bush St. San Francisco, Calif. 94120	do	Kern, Kings, Orange, Los Angeles, Santa Barbara, Ventura.
Texaco Inc	3350 Wilshire Blvd. Los Angeles, Calif. 90005	do	Los Angeles, Santa Barbara, Ventura.
Union Oil Co. of California	P.O. Box 7600 Los Angeles, Calif. 90054	do	Fresno, Kern, Los Angeles, Santa Barbara, Ventura.
Peat:			
Peter J. Gambetta	Route 1, Box 78 Brentwood, Calif. 94513	Reed-sedge bog	Contra Costa.
R. W. McClellan, Jr	151 Commercial Way Costa Mesa, Calif. 92627	Humus bog	Orange.
Vita-Peat Co., Inc	P.O. Box 428 Bethel Island, Calif. 94511	Reed-sedge bog	Contra Costa.
Perlite:			
American Perlite Co	11831 Vose St. North Hollywood, Calif. 91605	Open-pit mine	Inyo.
Petroleum:			
Atlantic Richfield Co	445 South Figueroa St. Los Angeles, Calif. 90054	Oilfields	Kern, Los Angeles, Monterey, Orange, Santa Barbara, Ventura.
Belridge Oil Co	1300 West 4th St. Los Angeles, Calif. 90017	do	Kern, Santa Barbara.
Chanslor-Western Oil & Development Co.	4549 Produce Plaza Los Angeles, Calif. 90058	do	Kern, Los Angeles, Orange, Ventura.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Petroleum—Continued			
Getty Oil Co	3810 Wilshire Blvd. Los Angeles, Calif. 90005	Oilfields	Fresno, Kern, Los Angeles, Monterey, Orange, Santa Barbara, Ventura.
Gulf Oil Corp	5400 Rosedale Highway Bakersfield, Calif. 93302	do	Fresno, Kern, Los Angeles, Orange, Santa Barbara, Ventura.
Humble Oil & Refining Co.	1800 Avenue of the Stars Los Angeles, Calif. 90067	do	Do.
Long Beach (City of) Dept. of Oil Properties.	925 Harbor Plaza Long Beach, Calif. 90801	do	Los Angeles.
Mobil Oil Corp	612 South Flower St. Los Angeles, Calif. 90017	do	Fresno, Kern, Kings, Los Angeles, Monterey, Orange, San Benito, San Luis Obispo, Santa Barbara, Ventura.
Occidental Petroleum Corp.	10889 Wilshire Blvd. Los Angeles, Calif. 90024	do	Contra Costa, Kern, Los Angeles, Santa Barbara.
Phillips Petroleum Co	1306 Santa Barbara St. Santa Barbara, Calif. 93104	do	Santa Barbara.
Shell Oil Co	1008 West 6th St. Los Angeles, Calif. 90017	do	Contra Costa, Fresno, Kern, Los Angeles, Orange, Santa Barbara, Ventura.
Signal Oil and Gas Co	1010 Wilshire Blvd. Los Angeles, Calif. 90054	do	Fresno, Kern, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.
Standard Oil Co. of California.	225 Bush St. San Francisco, Calif. 94120	do	Fresno, Kern, Kings, Los Angeles, Monterey, Orange, Santa Barbara, Ventura.
Texaco Inc	3350 Wilshire Blvd. Los Angeles, Calif. 90005	do	Fresno, Kern, Los Angeles, Monterey, Orange, Santa Barbara, Ventura.
Union Oil Co. of California.	461 South Boylston Los Angeles, Calif. 90017	do	Fresno, Kern, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.
Union Pacific Railroad Co.	5480 Ferguson Drive Los Angeles, Calif. 90022	do	Los Angeles, Ventura.
Phosphate rock: Cuyama Phosphate Corp.	401 Alameda De Las Pulgas San Mateo, Calif. 94402	Open-pit mine	Santa Barbara.
Platinum: Yuba Industries, Inc.	Star Route Marysville, Calif. 95901	Byproduct of gold operation.	Yuba.
Potassium salts: American Potash & Chemical Corp.	P.O. Box 2294 Los Angeles, Calif. 90054	Dry lake brines	San Bernardino.
Pumice:			
B.S.B. Cinder Co	Route 1, Box 562 Montague, Calif. 96064	Open-pit mine	Kern.
California Industrial Minerals Co.	P.O. Box 286 Friant, Calif. 93626	do	Madera.
Cinder Products Co	3450 Lakeshore Ave. Oakland, Calif. 94610	do	Lake.
Red Lava Products of California.	Star Route Clearlake Oaks, Calif. 95423	do	Do.
Shastalite Cinder Co	P.O. Box 341 Weed, Calif. 96094	do	Siskiyou.
U.S. Pumice Supply Co., Inc. (Featherock, Inc.)	6331 Hollywood Blvd. Los Angeles, Calif. 90028	do	Mono.
Rare-earth metals: Molybdenum Corp. of America.	Mountain Pass via Nipton, Calif. 92366	do	San Bernardino.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Salt:			
Leslie Salt Co.	505 Beach St. San Francisco, Calif. 94111	Solar evaporation and open-pit mine.	Alameda, Napa, San Bernardino, San Mateo.
Metropolitan Water District of Southern California.	P.O. Box 54153 Los Angeles, Calif. 90054	Solar evaporation	San Bernardino.
Pacific Salt & Chemical Co.	4262 Wilshire Blvd. Los Angeles, Calif. 90021	do	Do.
Standard Salt Co.	615 South Flower St. Los Angeles, Calif. 90017	do	Do.
Western Salt Co.	P.O. Box 149 San Diego, Calif. 92112	do	Kern, Orange, San Diego.
Sand and gravel:			
Arden Sand & Gravel Co.	977 Arden Way Sacramento, Calif. 95801	Open-pit mine	Sacramento.
Azusa Western, Inc.	P.O. Box 575 Azusa, Calif. 91702	do	Los Angeles.
Basalt Rock Co., Inc.	P.O. Box 2540 Napa, Calif. 94558	do	Sonoma.
Blue Diamond Concrete Metals.	P.O. Box 2678 Los Angeles, Calif. 90054	do	Los Angeles, Orange.
California Materials Co.	P.O. Box 845 Sun Valley, Calif. 91352	do	Los Angeles.
Canyon Rock Sand & Gravel.	P.O. Box 24 Santa Susana, Calif. 93063	do	Ventura.
Chandler's Palos Verdes Sand & Gravel Co.	P.O. Box 295 Lomita, Calif. 90717	do	Los Angeles.
Consolidated Rock Products Co.	2730 South Alameda St. Los Angeles, Calif. 90054	do	Los Angeles, Orange, San Bernardino, Ventura.
Crystal Silica Co.	Ottawa, Ill. 61350	do	San Diego.
H. G. Fenton Material Co.	702 Washington St. San Diego, Calif. 92112	do	Do.
Granite Construction Co.	7218 Perkins Branch Sacramento, Calif. 93940	do	Monterey, Sacramento, San Joaquin, Santa Clara, Yolo.
Hartman Concrete Materials Co.	P.O. Box 1632 Bakersfield, Calif. 93302	do	Kern.
International Pipe & Ceramic Corp.	2901 Los Feliz Blvd. Los Angeles, Calif. 90039	do	Amador.
Kaiser Industries Corp.	300 Lakeside Drive Oakland, Calif. 94612	do	Alameda, Contra Costa, Glenn, Santa Clara, Santa Cruz, Sonoma.
Kern Rock Co.	P.O. Box 3329 Bakersfield, Calif. 93305	do	Kern.
Livingston-Graham, Inc.	5500 North Peck Road El Monte, Calif. 91731	do	Los Angeles, Orange, San Bernardino, Ventura.
Madison Sand & Gravel Co.	P.O. Box 66 Madison, Calif. 95653	do	Yolo.
Manning Bros. Rock & Sand Co.	P.O. Box 204 Irwindale, Calif. 91706	do	Los Angeles.
Massey Sand & Rock Co.	P.O. Drawer P Indio, Calif. 92201	do	Riverside.
Nelson & Sloan	P.O. Box 488 Chula Vista, Calif. 92010	do	San Diego.
Niles Sand & Gravel Co., Inc.	P.O. Box 2248 Fremont, Calif. 94536	do	Alameda.
Owens-Illinois Glass Co.	P.O. Box 1035 Madison Avenue Toledo, Ohio 43601	do	Amador, Monterey, Riverside.
Owl Rock Products Co.	P.O. Box 47 Irwindale, Calif. 91707	do	Fresno, Los Angeles, Orange, Riverside, Ventura.
Owl-Service Rock Co.	P.O. Box 309 Riverside, Calif. 92501	do	San Bernardino.
Pacific Cement & Aggregates.	400 Alabama St. San Francisco, Calif. 94110	do	Alameda, Fresno, Monterey, Sacramento, San Joaquin, San Mateo, Santa Cruz, Tulare, Yolo.
A. J. Raisch Paving Co.	99 Pullman Way San Jose, Calif. 95111	do	Santa Clara.
Rhodes and Jamieson, Ltd.	P.O. Box 118 Oakland, Calif. 94604	do	Alameda.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
San Diego Consolidated Co.	P.O. Box 3089 San Diego, Calif. 92103	Open-pit mine	San Diego.
Santa Clara Sand & Gravel Co.	P.O. Box 338 Cupertino, Calif. 95014	do	Alameda, Santa Clara.
Southern Pacific Milling Co.	3555 Vineyard Ave. Oxnard, Calif. 93030	do	Santa Barbara, Ventura.
Standard Materials Co.	P.O. Box 3171 Modesto, Calif. 95350	do	Merced, Stanislaus.
Sully-Miller Contracting Co.	P.O. Box 432 Orange, Calif. 92669	do	Orange.
Teichert Aggregates	P.O. Box 928 Sacramento, Calif. 95804	do	Butte, Nevada, Placer, Sacramento, San Joaquin, Yolo, Yuba.
Triangle Rock Products, Inc.	P.O. Box 2083 San Bernardino, Calif. 92406	do	Los Angeles, Riverside, San Bernardino.
Tri-City Concrete	P.O. Box 672 Redlands, Calif. 92373	do	San Bernardino.
Silver:			
Paul Bare	P.O. Box 538 Lone Pine, Calif. 93545	Underground mine	Inyo.
Claude B. Lovestedt	P.O. Box 1496 Carson City, Nev. 89701	Open-pit and underground mines.	Alpine.
Monte Cristo Mining Corp.	P.O. Box 218 Las Vegas, Nev. 89101	Underground mine	Inyo.
Union Carbide Corp., Mining & Metals Division.	270 Park Ave., 38th Floor New York, N.Y. 10017	do	Do.
West Hill Exploration, Inc., T.A.C. Darwin Mines Dept.	Lone Pine, Calif. 93545	do	Do.
Sodium compounds:			
American Potash & Chemical Corp.	P.O. Box 2294 Terminal Annex Los Angeles, Calif. 90054	Dry lake brines	San Bernardino.
Stauffer Chemical Co.	636 California St. San Francisco, Calif. 94119	do	Do.
United States Borax & Chemical Corp.	P.O. Box 75128 Stanford Station Los Angeles, Calif. 90005	Open-pit mine	Kern.
Stone:			
American Cement Corp.	P.O. Box 832 Riverside, Calif. 92501	Open quarry and underground mine.	Los Angeles, Riverside, San Bernardino.
Basalt Rock Co., Inc.	P.O. Box 2540 Napa, Calif. 94558	Open quarry	Marin, Napa, Sonoma.
Calaveras Cement Division of The Flintkote Co.	San Andreas, Calif. 95249	do	Calaveras, Shasta.
California Portland Cement Co.	612 South Flower St. Los Angeles, Calif. 90017	do	Kern, San Bernardino.
Connolly-Pacific Co.	1925 Water St. Long Beach, Calif. 90802	do	Los Angeles.
V. R. Dennis Construction Co.	P.O. Box 20068 San Diego, Calif. 92120	do	San Diego.
Diamond Springs Lime Co.	P.O. Box 407 Diamond Springs, Calif. 95619	Open quarry and underground mine.	El Dorado.
East Bay Excavating Co., Inc.	28814 Mission Blvd. Hayward, Calif. 94544	Open quarry	Alameda.
Eaton & Smith	1215 Michigan St. San Francisco, Calif. 94107	do	San Luis Obispo.
El Dorado Limestone Co., Inc.	P.O. Box 8 Shingle Springs, Calif. 95682	Underground mine	El Dorado.
Felton Quarry	326 Fall Creek Drive Felton, Calif. 95018	Open quarry	Santa Cruz.
Fremont Land Co.	P.O. Box 2716 Fremont, Calif. 94536	do	Alameda.
Gallagher & Burke	344 High St. Oakland, Calif. 94601	do	Do.
Granite Rock Co.	P.O. Box 151 Watsonville, Calif. 95076	do	San Benito.
Hawley Rock, Inc.	P.O. Box 7 Irwindale, Calif. 91706	do	Riverside.
Hein Bros. Basalt Rock Co.	P.O. Box 162 Petaluma, Calif. 94952	do	Sonoma.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Hillsdale Rock Co., Inc.	500 Hillsdale Ave. San Jose, Calif. 95123	Open quarry	Santa Clara.
Hutchinson Co.	7360 Schmidt Lane El Cerrito, Calif. 94530	do	Marin.
Ideal Cement Co.	620 Denver National Bldg. Denver, Colo. 80202	Open quarry and dredge.	San Benito, San Mateo.
Kaiser Aluminum & Chemical Corp.	Moss Landing, Calif. 95039	Open quarry	Monterey.
Kaiser Cement & Gypsum Corp.	Permanente Road Permanente, Calif. 95014	do	San Bernardino, Santa Clara.
Kaiser Industries Corp.	300 Lakeside Drive Oakland, Calif. 94612	do	Contra Costa.
La Habra Products, Inc.	1631 West Lincoln Ave. Anaheim, Calif. 92803	do	San Bernardino.
Minnesota Mining & Manufacturing Co.	3M Center St. Paul, Minn. 55101	do	Riverside.
Monolith Portland Cement Co.	Box 65677 Glassell Station Los Angeles, Calif. 90065	do	Kern.
Neary Rock Quarry, Inc.	11920 Stonebrook Ave. Los Altos, Calif. 94022	do	Santa Clara.
Pacific Cement & Aggregates.	400 Alabama St. San Francisco, Calif. 94110	do	Alameda, Contra Costa, San Mateo, Santa Cruz.
Pacific Western Industries, Inc.	3810 Wilshire Blvd. Los Angeles, Calif. 90005	do	Kern.
Page Mill Quarry Corp.	P.O. Box 11487 Palo Alto, Calif. 94306	do	Santa Clara.
Chas. Pfizer & Co., Inc.	P.O. Drawer AD Victorville, Calif. 92394	do	Kern, San Bernardino.
Quarry Products, Inc.	P.O. Box 1147 Richmond, Calif. 94802	do	Contra Costa.
Rhodes & Jamieson Ltd.	P.O. Box 118 Oakland, Calif. 94604	do	San Mateo.
Silberberger Constructors, Inc.	P.O. Box 608 Vista, Calif. 92083	do	San Diego.
South Coast Asphalt Co., Inc.	P.O. Box 218 Carlsbad, Calif. 92008	do	Do.
Southwestern Portland Cement Co.	1034 Wilshire Blvd. Los Angeles, Calif. 90017	do	San Bernardino.
Stauffer Chemical Co.	636 California St. San Francisco, Calif. 94119	do	Inyo.
Tapo Minerals Corp.	P.O. Box 1485 Studio City, Calif. 91604	do	Ventura.
United States Lime Division of The Flintkote Co.	P.O. Box 57367 Flint Station Los Angeles, Calif. 90057	Open quarry and underground mine.	Tuolumne.
Vinnell Mining & Materials Corp.	1145 Westminster Ave. Alhambra, Calif. 91802	Open quarry	San Bernardino.
Sulfur:			
Magnaminerals, Inc.	1000 South Santa Fe Ave. Los Angeles, Calif. 90021	Open pit mine	Inyo.
Talc, pyrophyllite, and soapstone:			
Grantham Mines	1915 South Coast Highway Laguna Beach, Calif. 92651	Open-pit and underground mines.	Inyo.
Minerals Materials Co.	1145 Westminster Ave. Alhambra, Calif. 91800	Open-pit mine	San Bernardino.
Minerals, Pigments, & Metals Division, Chas. Pfizer & Co., Inc.	P.O. Drawer AD Victorville, Calif. 92394	Open-pit and underground mines.	Inyo, San Bernardino.
Pomona Tile Manufacturing Co.	216 South Reservoir St. Pomona, Calif. 91766	Underground mine	San Bernardino.
Standard Industrial Minerals, Inc.	Route 4, Box 1 Bishop, Calif. 93514	Open-pit and underground mines.	Inyo, Mono.
Bill Tonkin	Lone Pine, Calif. 93545	Open-pit mine	Inyo.
Western Talc Co., Inc.	Box 368 Yermo, Calif. 92398	Underground mine	San Bernardino.
Tungsten:			
Mines Exploration, Inc.	P.O. Box 17 Red Mountain, Calif. 92374	do	Do.
New Idria Mining & Chemical Co.	3457 South Cedar Ave. Fresno, Calif. 93745	do	Madera.
Union Carbide Corp., Mining & Metals Div.	270 Park Ave., 38th Floor New York, N.Y. 10017	do	Inyo.
Wollastonite: Chas. Pfizer & Co., Inc.	P.O. Drawer AD Victorville, Calif. 92394	Open pit	Riverside.
Zinc:			
Paul Bare	P.O. Box 538 Lone Pine, Calif. 93545	Underground mine	Inyo.
West Hill Exploration, Inc., T.A.C. Darwin Mines Dept.	Lone Pine, Calif. 93545	do	Do.

The Mineral Industry of Colorado

By Carl L. Bieniewski[1] and William C. Henkes[2]

Value of mineral production in Colorado during 1968, 4 percent over that of 1967, amounted to $359.5 million, a gain of $13.2 million. Primarily responsible for the gain was the increase of $15.6 million in the value of molybdenum.

The State led the Nation in the output of beryllium concentrate, molybdenum, tin, and vanadium and was second in output of carbon dioxide and tungsten. Molybdenum shipments of 61.7 million pounds established a State record, surpassing the previous high of 1966 by 4.4 million pounds. Sand and gravel production also established a new high of 23.1 million tons, 900,000 tons more than the 1966 record output.

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[1] Mining engineer, Bureau of Mines, Denver, Colo.

[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1.—Mineral production in Colorado [1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Carbon dioxide (natural) thousand cubic feet	182,701	$31	200,657	$34
Clays thousand short tons	596	1,274	616	1,222
Coal (bituminous) do	5,439	25,920	5,558	26,785
Copper (recoverable content of ores, etc.) short tons	3,993	3,053	3,451	2,888
Feldspar long tons	300	2	W	W
Gem stones	NA	118	NA	121
Gold (recoverable content of ores, etc.) troy ounces	21,181	741	22,638	[2] 889
Gypsum thousand short tons	77	265	98	354
Lead (recoverable content of ores, etc.) short tons	21,923	6,138	19,778	5,226
Lime thousand short tons	118	2,028	125	2,375
Manganiferous ore (5 to 35 percent Mn) short tons, gross weight	321	3	---------	---------
Molybdenum (content of concentrate) thousand pounds	52,040	84,728	61,684	100,296
Natural gas (marketed) million cubic feet	116,857	15,542	121,424	16,392
Natural gas liquids:				
LP gases thousand 42-gallon barrels	1,703	3,649	1,987	3,338
Natural gasoline and cycle products do	1,234	3,215	1,289	3,248
Peat short tons	21,988	204	28,457	250
Petroleum (crude) thousand 42-gallon barrels	33,905	99,003	31,937	94,215
Pumice thousand short tons	18	105	28	234
Pyrites thousand long tons	W	W	23	97
Sand and gravel thousand short tons	21,810	22,904	23,121	26,608
Silver (recoverable content of ores, etc.) thousand troy ounces	1,818	2,817	1,646	3,531
Stone thousand short tons	2,992	5,485	2,471	5,201
Tin (content of concentrate) long tons	31	59	33	64
Tungsten concentrate (60-percent WO_3 basis) short tons	1,276	3,039	1,893	4,413
Uranium (recoverable content U_3O_8) thousand pounds	2,537	[3] 20,299	2,706	[4] 20,009
Vanadium (recoverable in ore and concentrate) short tons	3,317	14,260	3,492	12,468
Zinc (recoverable content of ores, etc.) do	52,442	14,519	50,258	13,570
Value of items that cannot be disclosed: Beryllium concentrate, cement, fluorspar, iron ore, mica (scrap 1967), perlite, rare-earth metal concentrate, salt, and value indicated by symbol W	XX	16,834	XX	15,630
Total	XX	346,235	XX	359,458
Total 1957–59 constant dollars	XX	r 323,357	XX	p 330,891

p Preliminary. r Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Based on average U.S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968, and the New York selling price for the remainder of the year.

[3] Estimated based on $8.00 per pound f.o.b. mill.

[4] Estimated based on $8.00 per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 per pound for commercial sales.

Table 2.—Value of mineral production in Colorado, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Adams	$4,589	$5,338	Sand and gravel, petroleum, natural gas, lime, gold, stone, silver.
Alamosa	173	490	Sand and gravel, peat.
Arapahoe	1,914	2,448	Sand and gravel, petroleum, stone.
Archuleta	565	342	Sand and gravel, petroleum, natural gas, stone.
Baca	1,258	1,065	Natural gas, petroleum, sand and gravel, stone.
Bent	100	71	Sand and gravel, natural gas, petroleum.
Boulder	2,626	2,381	Sand and gravel, fluorspar, lime, stone, peat, tungsten concentrate, clays, gold, petroleum, silver, lead, zinc.
Chaffee	721	831	Stone, sand and gravel, peat, gold, gypsum.
Cheyenne	2	36	Petroleum, sand and gravel.
Clear Creek	W	14,701	Molybdenum, sand and gravel, silver, lead, zinc, copper, gold.
Conejos	47	111	Sand and gravel, silver, gold, stone, copper, lead.
Costilla	105	170	Pumice, sand and gravel.
Crowley	10	3	Sand and gravel.
Custer	123	99	Sand and gravel, perlite, stone, copper, silver, lead, gold, zinc.
Delta	2,961	2,649	Coal, sand and gravel, lime.
Dolores	W	W	Zinc, lead, silver, sand and gravel, stone, copper, gold, iron ore.
Douglas	902	684	Sand and gravel, clays, stone, gypsum.
Eagle	8,476	7,692	Zinc, silver, lead, copper, sand and gravel, gold, stone, pumice.
Elbert	303	160	Sand and gravel, clays.
El Paso	2,016	2,753	Sand and gravel, stone, lime, clays.
Fremont	10,239	10,699	Cement, stone, coal, gypsum, sand and gravel, clays, petroleum, uranium, feldspar, fluorspar.
Garfield	3,957	3,202	Vanadium, uranium, sand and gravel, stone, lime, natural gas, coal, petroleum.
Gilpin	33	W	Gold, peat, silver, lead, copper, zinc.
Grand	238	77	Sand and gravel, stone.
Gunnison	4,388	3,839	Coal, stone, sand and gravel, silver, lead, copper, zinc, gold.
Hinsdale	W	24	Lead, silver, zinc, stone, copper, gold, sand and gravel.
Huerfano	711	241	Coal, sand and gravel, clays, stone.
Jackson	712	620	Petroleum, natural gas, fluorspar.
Jefferson	W	W	Sand and gravel, uranium, clays, stone, gold, silver.
Kiowa	2,759	3,399	Petroleum, natural gas, sand and gravel, natural gas liquids.
Kit Carson	62	498	Sand and gravel, stone.
Lake	86,365	91,037	Molybdenum, tungsten concentrate, sand and gravel, pyrites, tin, peat, rare-earth metal concentrate, stone, lead, gold, zinc, silver, copper.
La Plata	7,905	7,765	Natural gas, natural gas liquids, sand and gravel, coal, petroleum, peat.
Larimer	11,335	9,864	Cement, stone, sand and gravel, petroleum, lime, natural gas liquids, gypsum, natural gas.
Las Animas	4,982	5,844	Coal, sand and gravel, stone, clays.
Lincoln	71	360	Sand and gravel, stone.
Logan	10,176	9,046	Petroleum, sand and gravel, natural gas liquids, natural gas, lime, stone.
Mesa	10,188	9,593	Uranium, vanadium, natural gas, sand and gravel, coal, natural gas liquids, stone.
Mineral	1,374	1,140	Lead, zinc, silver, copper, gold, sand and gravel.
Moffat	9,061	11,045	Petroleum, natural gas, coal, sand and gravel, gold, natural gas liquids, silver.
Montezuma	2,067	1,876	Petroleum, sand and gravel, natural gas, carbon dioxide.
Montrose	13,854	14,490	Uranium, vanadium, coal, sand and gravel, stone, salt.
Morgan	7,995	7,038	Petroleum, natural gas liquids, natural gas, sand and gravel, lime.
Otero	447	712	Sand and gravel, lime, stone.
Ouray	W	2,267	Zinc, lead, copper, silver, gold, sand and gravel.
Park	115	117	Peat, beryllium concentrate, stone, zinc, gold, silver, lead, copper.
Phillips	55	85	Sand and gravel, stone.
Pitkin	6,202	6,262	Coal, iron ore, natural gas, sand and gravel, silver, lead, zinc, copper, stone, gold.
Prowers	252	179	Sand and gravel, petroleum.
Pueblo	1,967	2,433	Sand and gravel, lime, clays, stone, zinc, lead, silver, copper, gold.
Rio Blanco	60,367	56,642	Petroleum, natural gas, natural gas liquids, sand and gravel, vanadium, uranium, coal, stone.
Rio Grande	185	276	Sand and gravel, stone.
Routt	6,609	6,226	Coal, petroleum, sand and gravel, pumice, stone.
Saguache	209	129	Sand and gravel, pumice, silver, copper, lead, clays, zinc, gold.
San Juan	4,679	4,074	Zinc, lead, silver, copper, gold, sand and gravel.
San Miguel	17,860	17,016	Uranium, vanadium, zinc, lead, copper, silver, gold, natural gas, sand and gravel, iron ore, petroleum.
Sedgwick	137	202	Lime, sand and gravel, natural gas, stone.
Summit	106	301	Sand and gravel, lead, zinc, silver, copper, gold, stone.
Teller	66	133	Peat, sand and gravel, stone.

See footnotes at end of table.

Table 2.—Value of mineral production in Colorado, by counties[1]—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Washington	$12,815	$12,458	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Weld	7,277	8,684	Petroleum, coal, sand and gravel, natural gas, lime, stone.
Yuma	206	256	Sand and gravel.
Undistributed [2]	11,320	7,287	
Total [3]	346,235	359,458	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Denver County not listed because no production was reported.

[2] Includes beryllium concentrate (1968) and gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Colorado business activity

		1967 r	1968 p	Change (percent)
Employment and labor force, annual average:				
Total labor force	thousands	814.6	842.0	+3.4
Total employment	do	788.3	816.8	+3.6
Total unemployment	do	26.3	25.2	−4.2
Total agricultural employment	do	47.6	46.5	−2.3
Total nonagricultural employment	do	740.7	770.3	+4.0
Mining	do	13.0	13.1	+.8
Contract construction	do	34.3	35.4	+3.2
Manufacturing	do	102.7	106.6	+3.8
Trade	do	151.2	161.0	+6.5
Government	do	159.9	166.4	+4.1
Service and miscellaneous	do	111.1	116.4	+4.8
All other	do	168.5	171.4	+1.7
Personal income:				
Total	millions	$6,191.0	$6,865.0	+10.9
Per capita		$3,068	$3,352	+9.3
Construction activity:				
Cement shipments to and within the State	thousand 376-pound barrels	4,727	5,083	+7.5
Total construction valuation	millions	$259.7	$285.9	+10.1
Residential value	do	$157.6	$204.6	+29.8
Nonresidential value	do	$102.1	$81.5	−20.2
Highway construction contracts awarded	thousands	$79.4	$45.2	−43.1
Farm marketing receipts	millions	$887.9	$974.4	+9.7
Mineral production	do	$346.2	$359.5	+3.8
Utility sales or consumption:				
Natural gas used	billion cubic feet	189.3	205.4	+8.5
Electric power used	million kilowatt hours	6,045.3	6,716.8	+11.1
Total State revenue	millions	$796.0	$876.2	+10.1

p Preliminary. r Revised.

Sources: Business Research Division, Graduate School of Business Administration, University of Colorado, Boulder, Colo. 80302; Engineering News-Record, v. 182, No. 14, Apr. 3, 1969, pp. 52–53; U.S. Bureau of Mines.

Thirty-two mineral commodities, two less than in 1967, were produced; manganiferous ore and mica were not produced in 1968. Thirteen commodities were classed as metals, 13 as nonmetals, and six as mineral fuels. Metals collectively accounted for 46 percent of the total value of mineral production; mineral fuels, 40 percent; and nonmetals, 14 percent. The leading commodity in each group, according to value, was molybdenum ($100.3 million), petroleum ($94.2 million), and sand and gravel ($26.6 million). The cumulative value of these three commodities represented 62 percent of the State mineral production value. Compared with 1967 values, six commodities of the metals group, four of the nonmetals group, and two of the mineral fuels group decreased in value; whereas seven of the metals group, eight of the nonmetals group, and four of the mineral fuels group had increases. Value

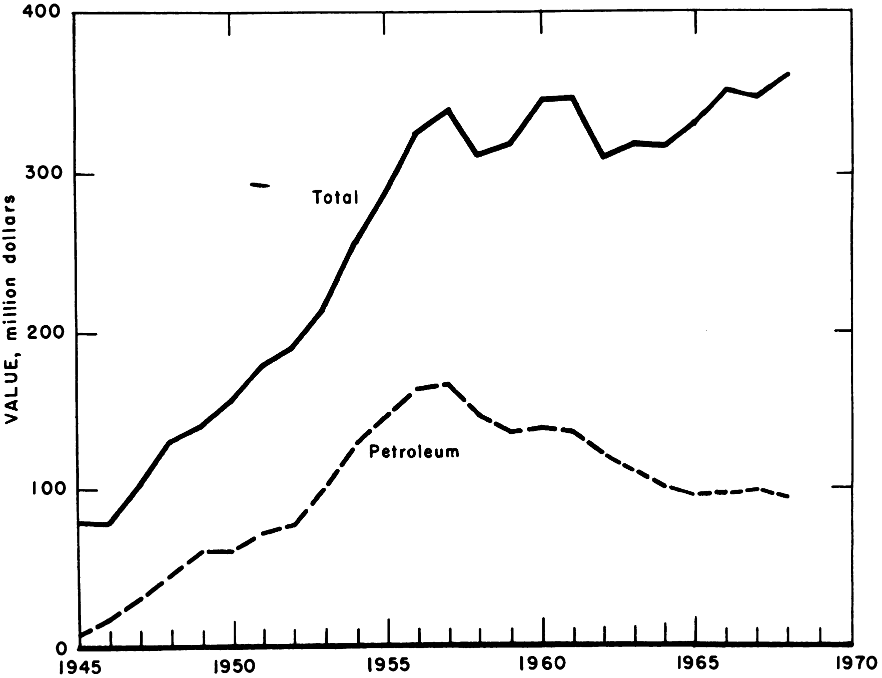

Figure 1.—Value of petroleum, and total value of mineral production in Colorado.

of feldspar was unchanged. Eighteen of the 32 mineral commodities produced in 1968 had outputs valued at over $1 million. Petroleum, the leading commodity from 1948 to 1967, was replaced by molybdenum as the one with the highest value. The combined values of molybdenum and petroleum represented 54 percent of the total value of mineral production.

Of the 63 counties, only Denver had no mineral production. Half of the 62 counties had increases in value of mineral production, and half decreases. Thirty-four counties had an output valued at $1 million or more, four between $500,000 and $1 million, 15 between $100,000 and $500,000, and nine less than $100,000. Lake County with $91.0 million and Rio Blanco with $56.6 million were the leading counties; production from the two counties together represented 41 percent of State value.

Employment and Injuries.—Preliminary data for 1968 and final data for 1967 compiled by the Bureau of Mines for employment and injuries in the mineral industries, excluding all mineral fuels except coal and peat, are shown in table 4.

Legislation and Government Programs.—The Office of Minerals Exploration (OME) awarded five contracts to provide financial assistance for mineral exploration in the State. Contracts were signed with F. W. Baumgartner to explore for copper at the Cora Belle and Red Mountain No. 3 properties in Ouray County; Loren E. Smith for copper, silver, and gold at the Forest Hill mine in Gunnison County; Triaqua Mining Co. for silver at the Mount Lincoln mines in Park County; McFarland & Hullinger for silver at the Keystone mine in Gunnison County; and Vitro Minerals Corp. for gold and silver at the Ice Lake properties in San Juan and San Miguel Counties. Government participation is to be 50 percent of the cost for the exploration project of F. W. Baumgartner, 62.5 percent for Loren E. Smith, and 75 percent for the other three projects.

Bureau of Mines reports released during the year that specifically concerned Colo-

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	1,354	219	297	2,334	2	72	31.71	6,368
Peat	21	131	3	15	-------	-------	-------	-------
Metal	4,693	273	1,284	10,264	7	407	40.34	6,764
Nonmetal	479	159	76	610	-------	4	6.55	388
Sand and gravel	1,372	182	250	2,014	2	42	21.85	6,319
Stone	500	242	121	978	-------	24	24.53	3,973
Total	8,419	241	2,031	16,215	11	549	34.54	6,237
1968:[p]								
Coal	1,315	223	294	2,293	6	71	33.57	16,936
Peat	35	159	6	29	-------	1	35.03	245
Metal	4,535	268	1,217	9,927	3	360	36.57	3,754
Nonmetal	505	173	88	702	-------	15	21.36	335
Sand and gravel	1,355	190	257	2,086	1	64	31.16	6,556
Stone	515	245	126	1,024	-------	19	18.55	1,457
Total	8,260	241	1,988	16,061	10	530	33.62	5,698

[p] Preliminary.

rado dealt with the silver potential of the Creede District,[3] oil yields of oil shale samples from a corehole,[4] procedure for drilling another corehole in oil shale and the results obtained,[5] and reservoir oil analyses in the Denver-Julesburg basin.[6]

Heavy construction projects, such as roads and dams, financed by Federal, State, county, and municipal funds, absorbed much of the production of cement, sand and gravel, and stone. State highway construction contracts awarded during the year totaled $45.2 million, considerably less than the 1967 amount of $79.4 million.[7] Contracts worth only $21.9 million were awarded for road building in the National System of Interstate and Defense Highways, compared with $53.8 million[8] in 1967, reflecting the cutback of some of the Federal Government's spending. The Sugar Loaf and Ruedi Dams were completed, and work continued throughout the year on the Chatfield Dam. Construction of the Silver Jack Dam, halted for the winter, is expected to be resumed in the spring of 1969.

REVIEW BY MINERAL COMMODITIES

METALS

Beryllium.—Colorado was one of three States in the Nation that had some production of beryllium concentrate. The other States, New Mexico and South Dakota, had less production than Colorado. State output increased considerably over that in 1967. Shipments of beryllium concentrates produced from low-grade beryl ore were resumed in the latter part of the year from the Boomer mine of U.S. Beryllium Corp. located near Lake George; the last reported shipments were in 1963. The ore was concentrated at the Tarryall mill of Mineral Concentrates & Chemical Co., Inc., located near the Boomer mine.

Beryl Ores Co. purchased beryl from some small producers and processed it into beryllium compounds at its plant near Arvada.

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[3] Meeves, Henry C., and Richard P. Darnell. Study of the Silver Potential, Creede District, Mineral County, Colo. BuMines Inf. Circ. 8370, 1968, 58 pp.

[4] Smith, John Ward, Laurence G. Trudell, and George F. Dana. Oil Yields of Green River Oil Shale From Colorado Corehole No. 1. BuMines Rept. of Inv. 7071, 1968, 28 pp.

[5] Dana, George F. Bureau of Mines-Atomic Energy Commission Colorado Corehole No. 3, Rio Blanco County, Colo. BuMines Open-File Report, July 1968.

[6] Cupps, C. Q., and J. Fry. Reservoir Oil Analyses, Denver-Julesburg Basin, Colo. BuMines Open-File Report, 1968.

[7] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1969 and Budgets for Maintenance. V. 182, No. 14, Apr. 3, 1969, pp. 52–53.

[8] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1968 and Budgets for Maintenance. V. 180, No. 14, Apr. 4, 1968, pp. 86–87.

Cadmium, Indium, and Thallium.—American smelting and Refining Co. (Asarco) recovered cadmium, indium, and thallium metal and thallous sulfate at its Globe plant in Denver from flue dust, dross, and other byproduct material of smelters and processing plants outside the State. The value of these products was not included as part of the mineral value for Colorado because of the out-of-State origin of the processed material.

Copper.—Copper production was down 14 percent in quantity and 5 percent in value. The increase in the average price of copper from 38.226 cents per pound to 41.847 cents prevented a further decrease in value. The decrease in quantity was due mainly to lower outputs at the Idarado, Keystone, and Emperius mines—the three principal sources in 1967. The total output came from 48 operations in 16 counties, compared with 35 operations in 17 counties in 1967. The output of copper from the 13 additional operations was not significant because the new operations were small; each had an output of less than 6 tons.

The Idarado mine of Idarado Mining Co. located in Ouray and San Miguel Counties accounted for about three-fourths of the State's output, even though copper production decreased 268 tons below the 1967 output. The drop was the result of less ore milled and lower copper content of the ore. Other mines that had production exceeding 100 tons of copper, in order of output, were the Sunnyside and Brenneman mines of Standard Metals Corp. in San Juan County, and the Eagle mine of The New Jersey Zinc Co., a subsidiary of Gulf & Western Industries, Inc., in Eagle County.

No mining and milling were done by McFarland & Hullinger, lessee, at Asarco's Keystone mine in Gunnison County; however, some stockpiled concentrates were shipped. Another principal source last year, the Emperius mine of Emperius Mining Co. in Mineral County, had an output of less than 100 tons of copper in 1968 because of a 5,000-ton drop in ore production and lower copper content of the ore milled.

Development work consisting of shaft sinking and drifting was done and construction work was begun on a 350-ton-per-day mill at the Summitville mine at Summitville. Previously a gold and silver operation, the property is being developed for a copper deposit discovered beneath the old workings. The work is managed by Cleveland-Cliffs Iron Co. which has a 40-percent interest in the operation; Union Pacific Railroad Co. also has 40-percent interest and W. S. Moore Co., 20 percent.

Gold.—Gold production was up 1,457 troy ounces, 7 percent above that of 1967. About three-fourths of the increase was due to greater gold production at the Idarado mine. The Idarado yielded 70 percent of the State's output.

Forty-nine lode and 15 placer mines had production, compared with 34 and 15, respectively, in 1967. In addition to output from these operations, 39 troy ounces of gold were obtained from cleanup operations and reprocessing of tailings. Gold from the placer operations totaled 1,707 troy ounces, 8 percent of the State production. Nine of the 15 placers were actually sand and gravel operations at which gold was recovered as a byproduct. Twelve of the 49 lode operations each had production of 100 troy ounces or more. In addition to the Idarado, the only other lode mines which had production exceeding 1,000 troy ounces were the Sunnyside and Brenneman mines.

Gold production was reported from 23 counties. The county with the greatest production was San Miguel, followed by San Juan and Ouray; output from these three counties totaled 18,961 ounces, 84 percent of the production for the State.

Iron Ore.—The output of iron ore was 16 percent below that of 1967 mainly because of a drop in production from the principal source, the Cooper Basin mine of Pitkin Iron Corp. in Pitkin County. The mine, operated by Morrison-Knudsen Co., Inc., under contract, was the source of 97 percent of the State's output. The magnetite ore from the mine was shipped to the Pueblo plant of CF&I Steel Corp. (CF&I). A small quantity of brown iron ore from Dolores and San Miguel Counties was shipped to Chas. Pfizer & Co., Inc., for use as paint pigment.

Containing about 65 percent iron, agglomerates were obtained by Industrial Chemicals Division, Allied Chemical Corp., from processing pyrites at its sulfuric acid plant in Denver. The output, sold for use

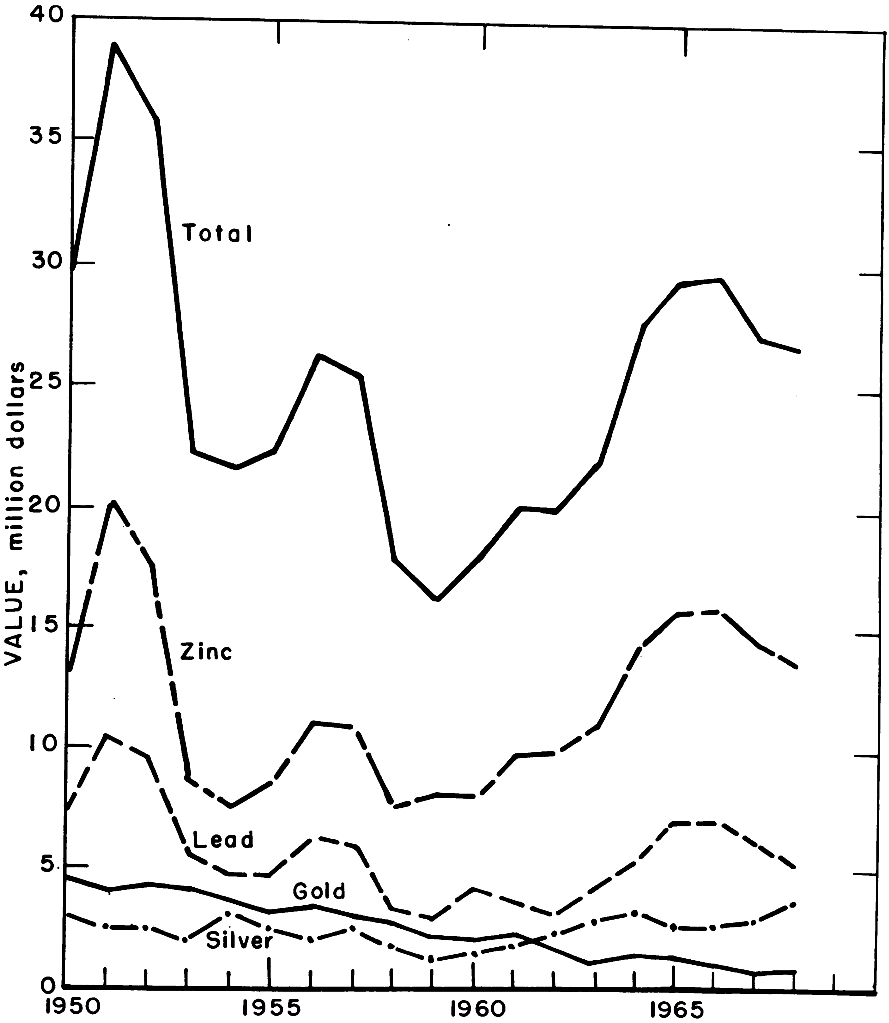

Figure 2.—Value of mine production of gold, silver, lead, and zinc, and total value of these minerals (including copper) in Colorado.

in making cement, was classified as a secondary product and, therefore, not considered as mineral production.

Lead.—Lead production, 10 percent below the 1967 quantity, declined 15 percent below the 1967 value because the average price dropped from 14.000 cents per pound of lead in 1967 to 13.212 cents. Of the 53 producing mines, six had outputs exceeding 500 tons and accounted for 90 percent of the production. The Idarado mine in Ouray and San Miguel Counties yielded 51 percent of the total output. Other principal operations, in order of output, were the Eagle mine in Eagle County, Brenneman and Sunnyside mines in San Juan County, Emperius mine in Mineral County, and Rico Argentine mine of Rico Argentine Mining Co. in Dolores County.

Six of the 19 counties with lead production had output exceeding 500 tons. The principal counties, ranked according to

Table 5.—Mine production of gold, silver, copper, lead and zinc, in terms of recoverable metals[1]

Year	Mines producing		Material sold or treated[2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1964	58	19	1,052	42,122	$1,474	2,626	$3,396
1965	58	13	1,021	37,228	1,308	2,051	2,652
1966	62	14	1,225	31,915	1,117	2,086	2,697
1967	39	15	1,173	21,181	741	1,818	2,817
1968	56	15	1,056	22,638	889	1,646	3,531
1858–1968	NA	NA	NA	40,851,657	923,781	783,088	622,345

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1964	4,653	$3,034	20,563	$5,388	53,682	$14,602	$27,894
1965	3,828	2,710	22,495	7,018	53,870	15,730	29,413
1966	4,237	3,065	23,082	6,978	54,822	15,898	29,755
1967	3,993	3,053	21,923	6,188	52,442	14,519	27,268
1968	3,451	2,888	19,778	5,226	50,258	13,570	26,104
1858–1968	332,037	116,685	2,924,248	369,201	2,324,087	463,288	2,495,300

NA Not available.

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore, old slag, or tailings shipped to smelters during the calendar year indicated.

[2] Does not include gravel washed.

output, were San Miguel, San Juan, Ouray, Eagle, Mineral, and Dolores.

As part of a joint venture of Resurrection Mining Co., a subsidiary of Newmont Mining Corp., and Asarco, the sinking of a 1,650-foot shaft was begun in September in Iowa Gulch. The project is to develop lead-zinc ore containing silver and gold in the Irene-Sunday-Hellena area of the Leadville district.

Molybdenum.—Two-thirds of the Nation's output of molybdenum came from Colorado. The Climax mine in Lake County and the Urad mine in Clear Creek County, both owned and operated by Climax Molybdenum Co., American Metal Climax, Inc. (AMAX), were the sources of the output. The Climax mine, the world's largest single source of molybdenum, celebrated its 50th anniversary. Capacity of the first mill, completed in 1918, was 250 tons per day; whereas this year the total mill capacity was 43,000 tons per day. The Urad mine operated on a full-time basis for the first time; production at this newly developed mine was begun during 1967.

AMAX announced that the plant which treated oxide ores at the Climax mine was shut down in the latter part of the year. The company, however, was able to produce sufficient molybdenum to meet consumer demands at a lower cost by recovering molybdenum from the sulfide ores at the Climax and Urad mines.

Sinking of the 23-foot-diameter shaft was continued throughout the year at AMAX's Henderson molybdenum project near the Urad mine. According to the company's annual report, the shaft is to reach the planned depth of 2,410 feet in 1969; initial production is planned in the mid-1970's with a capacity of approximately 50 million pounds of molybdenum per year.

Rare-Earth Metals.—AMAX recovered monazite (a combination of rare-earth phosphates) from mill tailings at the Climax molybdenum operation. The output was 32 percent greater than in 1967.

The Molybdenum Corp. of America rare-earth plant at Louviers went on stream to produce pure gadolinium oxide by a liquid ion-exchange separation process. The plant also produces other rare-earth products such as lanthanum, yttrium, and lutetium oxides.

Silver.—Although the quantity of silver decreased 172,000 troy ounces below the 1967 output, the value of silver production was the highest since 1941. The average price for silver reached an alltime high of $2.1446 per troy ounce, an increase of $0.5946 above the 1967 average price. The

Table 6.—Mine production of gold, silver, copper, lead, and zinc in 1968, by counties, in terms of recoverable metals

County	Mines producing [1]		Material sold or treated [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
Adams	---------	4	[3] 90,057	[3] 1,026	[3] $40,280	[3] 93,334	[3] $200,164
Boulder	3	2	439	199	7,813	1,050	2,252
Chaffee	---------	1	---------	187	7,341	---------	---------
Clear Creek	8	---------	9,128	77	3,023	61,489	131,869
Conejos	1	---------	(3)	(3)	(3)	(3)	(3)
Custer	2	---------	91	5	196	150	322
Dolores	1	---------	(3)	(3)	(3)	(3)	(3)
Eagle	1	---------	260,514	641	25,166	221,983	476,065
Gilpin	3	1	633	149	5,850	1,132	2,428
Gunnison	2	---------	2,167	25	982	39,060	83,768
Hinsdale	4	---------	440	9	358	2,354	5,048
Jefferson	---------	4	---------	561	22,025	86	184
Lake	1	---------	79	36	1,413	305	654
Mineral	2	---------	41,004	516	20,258	96,740	207,469
Moffat	---------	1	---------	10	393	1	2
Ouray	3	---------	94,390	2,689	105,570	194,036	416,130
Park	4	1	825	187	7,342	3,366	7,218
Pitkin	2	---------	(3)	(3)	(3)	(3)	(3)
Pueblo	---------	---------	50	1	39	427	916
Saguache	2	---------	1,911	9	353	7,332	15,724
San Juan	9	---------	194,888	3,026	118,801	247,123	529,980
San Miguel	3	---------	357,181	13,246	520,038	667,756	1,432,070
Summit	5	1	2,329	39	1,532	8,559	18,356
Total:							
1968	56	15	1,056,126	22,638	888,768	1,646,283	3,530,619
1967	39	15	1,172,893	21,181	741,335	1,817,699	2,817,433

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Adams	[3] 19	[3] $15,944	[3] 1,488	[3] $393,070	[3] 1,616	[3] $436,442	[3] $1,085,900
Boulder	---------	---------	(4)	92	(4)	13	10,170
Chaffee	---------	---------	---------	---------	---------	---------	7,341
Clear Creek	5	3,975	46	12,049	26	6,980	157,896
Conejos	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Custer	1	1,130	1	198	(4)	108	1,954
Dolores	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Eagle	126	105,622	1,629	430,394	24,375	6,581,088	7,618,335
Gilpin	1	711	8	2,259	2	472	11,720
Gunnison	29	23,978	309	81,571	45	12,150	202,449
Hinsdale	1	544	38	10,173	18	4,900	21,018
Jefferson	---------	---------	---------	---------	---------	---------	22,209
Lake	(4)	84	5	1,467	3	891	4,509
Mineral	91	75,748	1,593	420,948	1,529	412,911	1,137,329
Moffat	---------	---------	---------	---------	---------	---------	395
Ouray	525	439,561	1,976	522,085	2,773	748,616	2,231,962
Park	1	1,046	12	3,303	41	10,976	29,885
Pitkin	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Pueblo	(4)	335	6	1,519	16	4,172	6,981
Saguache	9	7,825	27	7,042	4	1,080	32,024
San Juan	389	325,277	3,974	1,050,090	7,499	2,024,824	4,048,972
San Miguel	2,252	1,884,496	8,437	2,229,420	12,110	3,269,808	9,335,832
Summit	2	2,009	229	60,459	201	54,230	136,586
Total:							
1968	3,451	2,888,280	19,778	5,226,139	50,258	13,569,661	26,103,467
1967	3,993	3,052,728	21,923	6,138,440	52,442	14,519,092	27,269,028

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[1] Operations at slag dumps and old mill or miscellaneous cleanups not counted as producing mines.

[2] Does not include gravel washed.

[3] Adams, Conejos, Dolores, and Pitkin Counties combined to avoid disclosing individual company confidential data.

[4] Less than ½ unit.

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1968, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode ore:							
Dry gold	2	351	125	551	1	9	-------
Dry gold-silver	8	2,355	381	5,993	1	14	6
Dry silver	16	70,425	284	158,143	176	204	69
Total [2]	26	73,131	790	164,687	178	228	75
Copper	2	1,397	6	2,324	52	--------	--------
Copper-lead-zinc	4	450,697	15,902	844,194	5,555	20,748	29,744
Lead	14	1,924	114	24,458	10	340	9
Lead-zinc and zinc [3]	[4] 18	527,189	4,060	576,600	1,049	17,741	70,546
Total [2]	35	981,207	20,082	1,447,571	6,666	38,829	100,299
Other lode material:							
Copper-lead cleanup	(5)	1	1	28	(6)	1	-------
Copper-lead-zinc cleanup	(5)	667	20	33,035	57	475	88
Lead mill cleanup	(5)	70	36	288	(6)	11	7
Lead-zinc cleanup	(5)	50	1	427	1	12	31
Zinc tailings	1	1,000	1	32	------	2	16
Total [2]	1	1,788	59	33,805	58	500	142
Total lode material [2]	56	1,056,126	20,931	1,646,063	6,902	39,556	100,516
Placer	15	---------	1,707	220	------	--------	--------
Total all sources	71	1,056,126	22,638	1,646,283	6,902	39,556	100,516

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Data may not add to totals shown because of independent rounding.
[3] Combined to avoid disclosing individual company confidential data.
[4] 16 lead-zinc mines and 2 zinc mines.
[5] From properties not classed as mines.
[6] Less than ½ unit.

Table 8.—Mine production of gold, silver, copper, lead, and zinc in 1968, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Amalgamation: Ore	2,527	832	---------	---------	---------
Concentration, and smelting of concentrates:					
Ore	18,090	1,481,014	6,679	38,963	100,345
Tailings	1	32	---------	2	16
Total	18,091	1,481,046	6,679	38,965	100,361
Direct-smelting:					
Ore	256	130,412	166	94	29
Cleanup	57	33,773	58	498	126
Total [1]	313	164,185	223	591	155
Placer	1,707	220	---------	---------	---------
Grand total	22,638	1,646,283	6,902	39,556	100,516

[1] Data may not add to totals shown because of independent rounding.

output came from 74 operations in 21 counties. Lode operations accounted for nearly all of the output; 990 troy ounces were obtained from placer operations, cleanups, and reprocessing of tailings. Twelve mines each had production of 10,000 troy ounces or more. Compared with their 1967 output, seven of the 12 mines, including the three principal operations, had decreases; four had increases; and one, the Bachelor-Syracuse operation in Ouray County, had no reported production in 1967. The three top operations—the Idarado, Eagle, and Sunnyside mines—were the only ones with production exceeding 100,000 troy ounces; together they yielded about two-thirds of the State production.

Of the 21 counties with silver production, only Eagle, Ouray, San Juan, and San Miguel Counties had outputs exceeding 100,000 troy ounces; San Miguel County led with 667,756 troy ounces. These four counties had a total production of 1,330,898 troy ounces, 81 percent of the State production.

Federal Resources Corp. announced in September that diamond drilling had encountered lead-zinc-copper ore with significant values in silver 700 feet below the lowest present workings in the Camp Bird mine near Ouray. Seven widely spaced drill holes were reported to have hit ore in thicknesses up to 50 feet. Additional drilling and exploration work were underway at yearend.

In April construction began on a 300-ton-per-day mill near Creede for processing silver-lead ore from the Bulldog Mountain property, under lease to Homestake Mining Co.; the company expected the mill to be in operation April 1969. During the year McCulloch Oil Corporation of California acquired the property from Bulldog Mountain, Inc.; the transaction, however, did not affect Homestake's lease agreement.

Tin.—Colorado and Alaska were the only States in the Nation with tin production; Colorado's output of 33 long tons exceeded that of Alaska. The source of tin in the State was the Climax molybdenum mine in Lake County. The tin concentrate produced from treating mill tailings was sold to Fred H. Lenway & Co., Inc., which upgraded the concentrate at its mill near Boulder.

Tungsten.—With 18 percent of the Nation's output, Colorado was surpassed only by California in the production of tungsten. Most of the State output was obtained as a byproduct of milling molybdenum ore at the Climax mine. The balance came from tungsten ore mined at the Eureka mine of Canyon Mining Corp. in Boulder County.

Uranium.—Although the production of uranium oxide (U_3O_8) was 7 percent greater than in 1967, the value was 1 percent less because of an increase in outside sales and a decrease in sales to the U.S. Atomic Energy Commission (AEC). The price used for AEC purchases was $8.00 per pound of U_3O_8; that for other purchases was estimated at $6.50. Colorado was third in AEC purchases of uranium oxide, with 10.6 percent (1,564,000 pounds) of the total quantity (14,675,000 pounds).

The U_3O_8 was recovered from 654,917 tons of ore obtained from 278 operations in seven counties; whereas, in 1967 the U_3O_8 was recovered from 615,585 tons of ore obtained from 262 operations in the same seven counties. The average grade of the 1968 uranium ore production was 0.223 percent U_3O_8, compared with 0.220 percent U_3O_8 for that of 1967. With 61 percent of the operations, Montrose was the leading county, producing 43 percent of the State output.

Of the 41 ore producers—11 less than in 1967—16 had ore production of 1,000 tons or more. The principal producers, in order of output, were Mining and Metals Division, Union Carbide Corp.; Climax Uranium Co., American Metal Climax, Inc.; Cotter Corp.; Foote Mineral Co.; and Shiprock, Ltd. Production from each of the five companies exceeded 10,000 tons, constituting 93 percent of the ore produced and 92 percent of the U_3O_8 recovered.

The four uranium mills operated during the year were the Uravan and Rifle mills of Union Carbide Corp., Grand Junction mill of Climax Uranium Co., and Canon City mill of Cotter Corp. The Climax operation was one of two uranium mills in the United States that produced U_3O_8 concentrate exclusively for the commercial market (outside sales). Some of the uranium ore mined in Colorado was processed at the Moab (Utah) mill of Atlas Minerals Division, Atlas Corp., and at the Shiprock (N. Mex.) mill of Foote Mineral Co.

Table 9.—Mine production of uranium (U_3O_8), by counties, in terms of recoverable content

County	1967			1968		
	Number of operations	Pounds	Value [1] (thousands)	Number of operations	Pounds	Value [2] (thousands)
Fremont	4	[3] 430,399	[3] $3,443	2	[3] 363,896	[3] $2,496
Garfield	3	([3])	([3])	2	([3])	([3])
Jefferson	3	([3])	([3])	3	([3])	([3])
Mesa	41	632,202	5,058	50	658,420	4,788
Montrose	156	943,895	7,551	170	1,166,797	8,860
Rio Blanco	2	([3])	([3])	3	([3])	([3])
San Miguel	53	530,826	4,247	48	516,444	3,866
Total [4]	262	2,537,322	20,299	278	2,705,557	20,009

[1] F.o.b. mill value; based on $8.00 per pound of U_3O_8 contained in concentrate.

[2] Value estimated, based on $8.00 per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 per pound for commercial sales; includes value of U_3O_8 obtained from Colorado ores processed at out-of-State mills.

[3] Fremont, Garfield, Jefferson, and Rio Blanco Counties combined to avoid disclosing individual company confidential data.

[4] Data may not add to totals shown because of independent rounding.

Foote Mineral Co. leased its uranium-vanadium properties on the Colorado Plateau to Climax Uranium Co. After Foote ceased mining the properties in midyear, Climax reopened some of the mines and processed ore from them at its uranium mill in Grand Junction. Previously, ores from these mines were processed at Foote's uranium mill at Shiprock, N. Mex., which the company also shut down in mid-1968.

Cotter Corp. completed a $1.25 million expansion at its uranium mill at Canon City; daily mill capacity was increased from 200 to 450 tons.

Union Carbide Corp. and Westinghouse Electric Corp. entered into a contract whereby Union Carbide will supply Westinghouse with 4 million pounds of uranium oxide from Union Carbide operations in Colorado and Wyoming in the period 1970–73.

Denison Mines, Ltd., of Canada, and nine major Japanese utility companies signed an agreement in September for exploring and developing uranium resources in the State. Under the agreement Denison and the other companies were to share costs equally; an estimate of the cost for the first 6 years was $4 million.

Uranium-exploration activity continued at a high level. According to AEC press releases 1.3 million feet of surface exploration and development drilling were performed during the year, compared with 752,000 feet in 1967.

Vanadium.—Fifty-four percent of the Nation's output of vanadium came from Colorado. The State output was 5 percent greater than in 1967. In the form of fused vanadium oxide (V_2O_5), the vanadium was recovered from uranium-vanadium ores processed at the uranium mills of Climax Uranium Co. at Grand Junction, Union Carbide Corp. at Rifle and Uravan, and Foote Mineral Co. at Shiprock, N. Mex.

According to Foote Mineral Co.'s stockholder report for the first 6 months of 1968, the uranium-vanadium properties on the Colorado plateau were leased to Climax Uranium Co. with the provision that Foote would receive payments on ore recovered and concurrently would purchase the vanadium pentoxide produced from the properties. Many of Foote's properties were in the southwest part of Colorado.

Zinc.—Zinc production decreased 4 percent in quantity and 7 percent in value. The average price was 13.500 cents per pound in 1968, a slight decrease from the 1967 average price of 13.843 cents. Of the 36 mines with production, seven had outputs of at least 500 tons of zinc. The leading mines, in order of output, were the Eagle mine in Eagle County, Idarado mine in Ouray and San Miguel Counties, Sunnyside and Brenneman mines in San Juan County, Rico Argentine mine in Dolores County, Emperius mine in Mineral County, and Belle Creole mine of Standard Metals Corp. in San Juan County. These seven mines yielded 97 percent of the State output.

Eagle County with about half of the State output led the 18 counties with zinc production. Other principal counties, in order of output, were San Miguel, San Juan, Ouray, Dolores, and Mineral. The six leading counties accounted for 99 percent of the State output.

At yearend The New Jersey Zinc Co. shut down its zinc-concentrate roasting plant at Canon City. Zinc concentrates produced at the company's Gilman operation will be shipped to the company's zinc smelter at Depue, Ill.; a new fluid-column roasting plant is in operation at the smelter.

MINERAL FUELS

Carbon Dioxide.—Marketed carbon dioxide, produced from the McElmo field, Montezuma County, continued to increase, up 9.8 percent from the 182.7 million cubic feet sold in 1967.

As in the past the oil-contaminated carbon dioxide produced from the McCallum field, Jackson County, was unmarketable and, after separation of the oil, was vented to the atmosphere. In 1968 some 4.3 billion cubic feet of carbon dioxide was vented compared with 10.0 billion in 1967.

Coal (Bituminous).—Coal production continued an upward trend with a modest increase of 2 percent over the 1967 output, even though there were only 54 producing mines (49 underground and five strip) compared with 63 in 1967. The output of 5.6 million tons came from the same 14 counties that had production last year; nine counties showed increases and five decreases in output. Routt with five mines had the greatest output, 1.7 million tons, and was the only one having production exceeding 1 million tons.

Twenty-two mines had an output between 1,000 and 10,000 tons, 19 between 10,000 and 100,000 tons, eight between 100,000 and 500,000 tons, and five between 500,000 and 1 million tons. The five operations with the largest production were, in order of output, the Allen underground mine of CF&I in Las Animas County, Somerset underground mine of United States Steel Corp. in Delta and Gunnison Counties, Edna strip mine of The Pittsburg & Midway Coal Mining Co., Seneca strip mine of Peabody Coal Co. (Seneca Coals, Ltd.), and Energy strip of Energy Coal Co. The three strip mines are in Routt County.

Fifty-seven percent of the State output was shipped to electric-power generating plants, 39 percent to steel mills where the coal was converted to coke for use in the steelmaking process, and the balance used for heating.

The average price of coal produced was $4.82 per ton, down $0.15 from the 1967 average. Coal from underground mines averaged $5.48 per ton and from strip mines $3.43, compared with $5.50 and $3.36, respectively, in 1967.

Peabody Coal Co., operating the Nucla strip mine in Montrose County and the Seneca strip mine in Routt County, was

Table 10.—Coal (bituminous) sold or used[1] in 1968, by counties

County	Number of mines operating			Sold or used (short tons)		
	Underground	Strip	Total	Underground	Strip	Total
Delta	4	--------	4	358,979	-----------	358,979
Fremont	13	--------	13	232,343	-----------	232,343
Garfield	1	--------	1	2,426	-----------	2,426
Gunnison	5	--------	5	512,695	-----------	512,695
Huerfano	2	--------	2	26,638	-----------	26,638
La Plata	4	--------	4	22,526	-----------	22,526
Las Animas	4	--------	4	771,280	-----------	771,280
Mesa	4	1	5	98,302	30,865	129,167
Moffat	2	--------	2	347,713	-----------	347,713
Montrose	------	1	1	-----------	69,164	69,164
Pitkin	2	--------	2	702,284	-----------	702,284
Rio Blanco	2	--------	2	5,667	-----------	5,667
Routt	2	3	5	28,719	1,694,873	1,723,592
Weld	4	--------	4	653,900	-----------	653,900
Total	49	5	54	3,763,472	1,794,902	5,558,374

[1] Excludes mines producing less than 1,000 short tons.

acquired by Kennecott Copper Corp.; Peabody will continue to operate under its own name but as a wholly owned subsidiary of Kennecott.

Natural Gas.—Marketed natural gas increased 3.9 percent in quantity and 5.5 percent in value over the comparable figures for 1967. The Colorado Oil and Gas Conservation Commission[9] reported that production of natural gas increased 1.2 percent, from 125.5 billion cubic feet in 1967 to 127.0 billion in 1968.

Leading counties for marketed natural gas were relatively unchanged from the ranking of 1967—La Plata was first with 39.8 billion cubic feet, Rio Blanco second with 24.0 billion, and Moffat third with 21.6 billion. Morgan County displaced Mesa County as fourth-ranking county with 8.6 billion cubic feet; much of the increase from Morgan County may be attributed to operations of the Fort Morgan gas storage field.

As in the past the Ignacio-Blanco field, La Plata County, with output of 33.1 billion cubic feet, was the principal producer of dry gas; production was from the Dakota, Fruitlands-Pictured Cliffs, and Mesaverde Formations, all Cretaceous. Piceance Creek, with a yield of 12.0 billion cubic feet, ranked second among dry-gas fields; Divide Creek, with 5.3 billion cubic feet, third; and West Hiawatha and Powder Wash, Moffat County, ranked fourth and fifth with 5.1 billion cubic feet each. Production of natural gas at Dragon Trail field, Rio Blanco County, more than doubled because of increased drilling by Continental Oil Co., the unit operator, which completed an additional 20 gas wells.

Again, the Rangely-Weber reservoir yielded the largest quantity of wet gas; of its output of 10 billion cubic feet, 3.4 billion was returned to the reservoir for pressure maintenance. Wilson Creek field, also in Rio Blanco County, produced 4 billion cubic feet of wet gas; 3 billion was returned to the reservoir.

Annual gas reserve estimates of the American Gas Association, Inc. (AGA), and the American Petroleum Institute (API)[10] for 1968 list 1.7 trillion cubic feet for Colorado, a loss of 109.2 billion cubic feet, 6.2 percent. New fields and new pools added 22.5 billion cubic feet, and extensions and revisions had a net loss of 16.5 billion.

The State had five gas storage projects—Asbury Creek, Fort Morgan, House Creek, Leyden mine, and Springdale. At the beginning of 1968 the projects had in storage 15.4 billion cubic feet of gas; 6.8 billion were injected and 6.7 billion withdrawn for a yearend balance of 15.5 billion cubic feet. The Fort Morgan field was the most active—3.6 billion cubic feet were injected and 3.5 billion were withdrawn. The Leyden mine, a converted coal mine, was second with 2.5 billion cubic feet injected and 2.3 billion removed.

Rocky Mountain Natural Gas Co., Inc., completed a 68-mile, 19-inch gas pipeline from the Andy's Mesa field, San Miguel County, to Delta, where it joined Rocky Mountain's existing line. Andy's Mesa field was discovered in 1967; by yearend 1968, six gas wells had produced 943.2 million cubic feet of gas.

Late in the year El Paso Natural Gas Co. and Northwest Pipeline Corp. agreed on terms whereby the latter would acquire the facilities of El Paso's Pacific Northwest Division. Under antitrust proceedings dating back to 1962, El Paso had been ordered to divest itself of facilities it acquired in 1959 through merger with Pacific Northwest Pipeline Corp. Northwest Pipeline Corp. is wholly owned by Colorado Interstate Corp. (formerly Colorado Interstate Gas Co.) of Colorado Springs. Facilities involved in the divestiture include more than 2,800 miles of gas pipelines, over 1,000 miles of gathering lines, compressor stations with capacity of more than 130,000 horsepower, and dehydration and gasoline plants; estimated book value was $223.2 million.

Cascade Natural Gas Corp. built facilities valued at approximately $685,000 to increase its gas take from the Dragon Trail area. In addition to gathering lines, the company built a 4,050-horsepower compressor station. The construction was part of a project to enable Cascade to furnish 66.7 million cubic feet of gas per day to

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[9] The Oil and Gas Conservation Commission of the State of Colorado. Colorado Oil and Gas Statistics. 1968, pt. 1, p. 6. All field natural gas and petroleum-production figures cited in the chapter are from this work.

[10] American Gas Association, Inc., American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada as of Dec. 31, 1968. V. 23, May 1969, p. 120.

Mountain Fuel Supply Co. Continental Oil Co. drilled additional wells in the Dragon Trail field to supply the gas.

Of the four gas discoveries during the year, only one appeared to be significant. Skelly Oil Co., Federal-C No. 1, sec 22, T 10 N, R 94 W, Moffat County, discovered the Bighole field. It was completed for a daily flow gage of 1.1 million cubic feet of gas and 12 barrels of condensate from the Lewis Formation (Tertiary) from perforations 7,536 to 7,586 feet.

The deepest well ever drilled in Colorado was completed as a gas well in the Piceance Creek field. The Mobil Oil Corp., Piceance Creek No. 52–19–G, sec 19, T 2 S, R 96 W, Rio Blanco County, begun in 1966, was completed in February 1968; it drilled to a total depth of 19,710 feet in Pennsylvanian rocks before being plugged back for completion in the Wasatch Formation (Tertiary) with a flow gage of 10.2 million cubic feet of gas per day.

A second experiment was planned to stimulate gas production from a low-permeability sandstone by use of a nuclear explosion. Project Rulison, Garfield County, was proposed to fracture the tight Mesaverde Formation (Cretaceous) in that Rulison field as Project Gasbuggy fractured the Pictured Cliffs Formation (Cretaceous) in New Mexico in December 1967. Austral Oil Co., Inc., in cooperation with the AEC, the Bureau of Mines, and the Los Alamos Scientific Laboratory, was preparing to detonate a 50-kiloton nuclear device at 8,500 feet in the Mesaverde. Although the force of the Rulison device will be twice as large as that used in Project Gasbuggy, its physical size will be about half that of the Gasbuggy device.

Natural Gas Liquids.—Total output of natural gas liquids increased 11.5 percent in quantity, but declined 4.0 percent in value because of a lower average unit value for LP gases. LP gases increased 16.7 percent and natural gasoline 4.5 percent in quantity.

The State reported that natural gas throughput of the gasoline plants was 95.5 billion cubic feet for the year; output was 3.3 million barrels of products;[11] input increased 7.5 percent and output 11.2 percent.

The Buck Peak plant of Western Slope Gas Co., Moffat County, ceased operations in February. The Bijou plant of Associated Oil & Gas Co., Morgan County, and the Roggen-Southwest plant of McWood Corp., Weld County, were closed in 1967. Closure of these plants left 12 operating plants at yearend.

Chadbourne Corp., Midland, Tex., was nearing completion of a 30-million-cubic-foot-per-day gasoline plant in the Piceance Creek field, Rio Blanco County. Daily output capacity of the refrigerated-absorption plant was to be 9,000 gallons of propane and 11,000 gallons of combined natural gasoline and LP gases. Completion date was to be early 1969.

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[11] Part 4, page 4 of work cited in footnote 9.

Table 11.—Gas input and products at natural gas liquids extraction plants in 1968

Plant	County	Owner	Gas input (million cubic feet)	Products (thousand barrels)
Adena	Morgan	Union Oil Company of Calif	7,108	601
Buck Peak	Moffat	Western Slope Gas Co	4	(1)
Fort Morgan	Morgan	Colorado Interstate Gas Co	107	1
Fruita	Mesa	Continental Oil Co	5,658	116
Little Beaver	Washington	do	582	88
Loveland	Larimer	Associated Oil & Gas Co	161	18
McClave	Kiowa	Fleetwood Drilling Co	736	25
Minto	Logan	Sunray-DX Oil Co	53	10
Padroni	do	Associated Oil & Gas Co	64	8
Rangely	Rio Blanco	Chevron Oil Co	9,704	729
San Juan	La Plata	El Paso Natural Gas Co	64,096	987
Vallery	Morgan	Associated Oil & Gas Co	809	65
Wilson Creek	Rio Blanco	Texaco Inc	3,936	374
Yenter	Logan	Associated Oil & Gas Co	2,526	291

[1] Less than ½ unit.

Source: The Oil and Gas Conservation Commission of the State of Colorado. Colorado Oil and Gas Statistics. Part IV: Gasoline and Extraction Plants. 1968, 4 pp.

Oil Shale.—In May the U.S. Department of the Interior issued a report describing possible developments in oil shale technology.[12] The report was primarily an outgrowth of comments solicited and received on regulations governing leasing of oil shale lands proposed by the Secretary of the Interior. The report was confined to estimates of costs of producing shale oil by conventional mining techniques rather than by in situ combustion. The report estimated that costs of shale oil recovery by conventional methods would range from $1.42 to $3.28 per barrel, not counting lease costs, and, for in situ recovery, would range from $2.98 to $6.84 per barrel.

Later, in September, the Department offered three oil shale tracts for lease in Rio Blanco County. Test Lease No. 1, in T 2 S, R 98 W, covering 1,260 acres, was estimated to contain 900 million barrels of recoverable shale oil. Test Lease No. 2, T 3 S, R 96 W, 5,120 acres, contained an estimated 500 million barrels of oil. Test Lease No. 3, in T 1 N, Rs 99–100 W, contained an estimated 900 million barrels of oil in 5,083 acres. Before offering bids, interested companies were invited to drill exploratory coreholes on the tracts. Three of the five companies indicating interest in the tracts drilled a total of five coreholes on Test Leases Nos. 1 and 2. The Bureau of Mines drilled a corehole on Test Lease No. 3 and made public the information obtained. When bids were submitted on December 20, only Test Leases Nos. 1 and 2 received bids. The Oil Shale Corp. bid $249,000 for Test Lease No. 1 and $250,000 for Test Lease No. 2; and an individual, Fred C. Krafts, Eugene, Oreg., bid $625.50 for Test Lease No. 1. The bids were rejected by the Department of the Interior as being "inadequate." Numerous explanations were offered for the low level of bidding. Industry appeared to believe that it indicated economic and technologic problems relative to other sources of petroleum, such as the new reserves on the Alaskan North Slope, on the Outer Continental Shelf, and from tar sands or foreign oil; other possible reasons were objections to lease terms and the high capital investments necessary for a shale-oil plant.

As mentioned before, the Laramie Petroleum Research Center, Bureau of Mines, Laramie, Wyo., drilled a corehole on Test Lease No. 3 in sec 21, T 1 N, R 99 W. The hole, begun on September 14, was drilled to 1,801 feet; the cores were analyzed, electrical and density logs were run in the corehole, and results were made available in open-file reports. The Bureau of Mines also published a report on Colorado Corehole No. 1.[13]

Early in February, Atlantic Richfield Co. and Equity Oil Co. announced plans whereby Atlantic Richfield would acquire an undivided 80-percent interest in part and 50-percent interest in other holdings of Equity in oil shale leases in Rio Blanco and Garfield Counties. The 80-percent interest is in Equity's half interest in a 20,000-acre block held with Mobil Oil Corp.; the 50-percent interest is in a 1,000-acre block of deeper oil shale reserves. The price to be paid in equal installments over 25 years by Atlantic Richfield is $27 million. Equity has experimented since 1964 on an in situ process for extracting shale oil using heated natural gas; this experiment will be expanded with Atlantic Richfield's help and research facilities.

Peat.—The peat output, 28,457 tons, was 6,469 tons greater than in 1967. Peat was produced at 17 operations, three more than in the previous year. Four operations were in Boulder County, three each in Park and Teller Counties, two each in Gilpin and Lake Counties, and one each in Alamosa, Chaffee, and La Plata Counties. Of the total output, 16,882 tons were moss type; 7,282 tons, humus; and 4,293 tons, reed-sedge. Average price for peat was $8.79 per ton, $0.50 less than that of 1967. Three-fourths of the output was sold unprocessed; the balance was shredded and then either shipped or dried. Most of the peat was bulk shipped; only 21 percent was packaged. Eighty-three percent of the peat went for use for general soil improvement. Other uses were for packing flowers, plants, and shrubs; making mixed fertilizers; and potting soils.

Petroleum.—Petroleum declined 5.8 percent in quantity and 4.8 percent in value and dropped from first to second place in value among the mineral commodities in the State. The decrease in production, nearly 2 million barrels, resulted from further depletion of reservoirs and the decline in exploratory drilling.

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[12] U.S. Department of the Interior. Prospects for Oil Shale Development: Colorado, Utah, and Wyoming. May 1968, 158 pp.

[13] Work cited in footnote 4.

Rio Blanco County, with the two top-ranking fields in the State, yielded 54 percent of the State total crude oil production. Washington and Logan Counties again were ranked second and third, with 12.8 and 7.6 percent of the production.

Table 12.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1967	1968	Principal fields in 1968, in order of production
Adams	391	443	Middlemist, Badger Creek, Beryl, Mocassin, Roman Nose.
Arapahoe	253	357	Black Jack.
Archuleta	60	55	Price Gramps.
Baca	97	71	Flank.
Bent	2	1	McClave, Lubers.
Boulder	2	1	Boulder.
Cheyenne	--------	9	Cheyenne Wells.
Fremont	21	23	Florence-Canon City.
Garfield	(1)	(1)	Mam Creek.
Jackson	229	198	McCallum, Battleship.
Kiowa	771	1,015	Brandon.
La Plata	24	24	Red Mesa.
Larimer	410	329	Wellington, Loveland.
Logan	2,885	2,418	Saber, Northwest Graylin, Mount Hope, West Padroni, Bonanza, Minto, Yenter.
Moffat	1,940	2,200	Maudlin Gulch, Powder Wash, Danforth Hills, Iles.
Montezuma	529	436	Cache, Marble Wash, Flodine Park.
Morgan	1,802	1,345	Boxer, Adena, Peterson, Zorichak, Sand River.
Prowers	5	1	Comanche.
Rio Blanco	19,006	17,231	Rangely, Wilson Creek, Nine Mile.
Routt	99	89	Grassy Creek, North Sage Creek, Tow Creek.
San Miguel	------	2	Andy's Mesa.
Washington	4,137	4,081	Plum Bush Creek, Rush Willadel, Big Beaver, Bison, Westfork, Cimarron, Lindon.
Weld	1,241	1,608	Border, Black Hollow, Pierce.
Yuma	1	--------	
Total	33,905	31,937	

[1] Less than ½ unit.

Source: The Oil and Gas Conservation Commission of the State of Colorado. Colorado Oil and Gas Statistics, 1968, Part II: Oil and Gas Production. 89 pp.

Table 13.—Principal oilfields in 1968

Field	County	Production: Oil (barrels)	Production: Gas (thousand cubic feet)	Cumulative production to Jan. 1, 1969: Oil (barrels)	Cumulative production to Jan. 1, 1969: Gas (thousand cubic feet)
Rangely (Weber)	Rio Blanco	14,758,831	10,005,914	[r] 416,006,173	[r] 658,272,454
Wilson Creek	do	1,918,017	4,013,545	64,929,399	44,197,680
Maudlin Gulch	Moffat	1,385,792	277,498	[r] 3,894,396	[r] 781,747
Brandon	Kiowa	994,306	----------	2,037,306	----------
Border	Weld	564,207	865,402	593,154	1,308,085
Boxer	Morgan	414,374	1,392,336	1,476,171	3,187,331
Adena	do	408,625	3,813,820	58,910,193	75,323,451
Plum Bush Creek	Washington	389,245	44,775	17,181,760	1,951,292
Rangely (Mancos)	Rio Blanco	373,483	94	[r] 11,262,884	116
Black Hollow	Weld	367,364	16,716	8,720,393	263,221
Rush Willadel	Washington	318,757	420	2,470,856	12,464
Pierce	Weld	289,088	30,346	6,489,194	213,998
Saber	Logan	286,981	1,418,111	1,140,987	6,437,190
Big Beaver	Washington	286,782	30,960	10,215,084	1,496,740
Black Jack	Arapahoe	284,626	3,975	531,288	5,116
Powder Wash	Moffat	274,296	5,060,086	4,458,428	82,558,981
Bison	Washington	273,185	----------	3,223,783	2,467
Westfork	do	247,745	----------	2,585,111	888,049
Cimarron	do	227,362	----------	235,625	----------
Lindon	do	210,992	----------	2,439,288	10,462
Graylin, NW	Logan	182,586	33,493	11,528,964	11,060,146
Nine Mile	Rio Blanco	162,149	----------	411,408	----------
Danforth Hills	Moffat	161,109	44,306	2,664,916	239,862
Wellington	Larimer	161,031	76,633	6,920,862	18,405,154
Mount Hope	Logan	155,117	16,259	6,194,912	6,881,429

[r] Revised.

Source: The Oil and Gas Conservation Commission of the State of Colorado. Colorado Oil and Gas Statistics, 1968, Part II: Oil and Gas Production. 89 pp.

Table 14.—Oil and gas well drilling in 1968, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Adams	1	---	15	16	94,977
Archuleta	---	---	1	1	1,565
Baca	---	---	9	9	41,277
Bent	---	---	1	1	5,600
Cheyenne	2	---	2	4	22,571
Delta	---	---	1	1	7,650
Dolores	---	---	2	2	12,007
Elbert	1	---	16	17	101,797
El Paso	---	---	2	2	3,075
Grand	---	---	1	1	6,811
Kiowa	3	---	12	15	80,203
Kit Carson	---	---	4	4	20,769
La Plata	---	1	2	3	8,465
Logan	1	---	27	28	144,485
Mesa	---	---	1	1	7,644
Moffat	---	1	11	12	71,074
Montezuma	---	---	13	13	50,100
Montrose	---	---	1	1	7,998
Morgan	1	1	15	17	98,097
Otero	---	---	2	2	8,105
Phillips	---	---	1	1	3,996
Prowers	---	---	5	5	27,512
Rio Blanco	---	---	13	13	74,004
Routt	---	---	3	3	10,099
San Miguel	---	1	1	2	18,285
Washington	5	---	69	74	338,316
Weld	2	---	15	17	110,436
Yuma	---	---	4	4	17,441
Total	16	4	249	269	1,394,359
Development completions:					
Adams	5	---	9	14	81,726
Elbert	3	---	1	4	22,687
Baca	---	4	3	7	23,932
Garfield	---	1	---	1	8,516
Kiowa	5	1	---	6	29,245
Kit Carson	---	---	2	2	10,220
La Plata	3	---	5	8	33,948
Larimer	2	---	---	2	10,935
Las Animas	---	---	1	1	2,220
Logan	1	1	8	10	50,418
Moffat	8	6	9	23	129,684
Montezuma	1	---	2	3	17,975
Montrose	---	---	1	1	9,150
Morgan	4	2	10	16	93,847
Rio Blanco	24	28	12	64	296,859
Routt	1	---	---	1	5,397
San Miguel	---	2	3	5	44,485
Washington	16	1	15	32	153,449
Weld	20	---	6	26	173,859
Total	93	46	87	226	1,198,542
Total all drilling	109	50	336	495	2,592,901

Source: Committee on Statistics of Drilling, American Association of Petroleum Geologists.

Table 15.—Oil and gas discoveries in 1968

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks
			Section	Township	Range				Barrels of oil per day	Thousand cubic feet of gas per day		
Adams: Keystone	No. 3 Wykoff	J. L. Cramer	10	2 S	57 W	"J" Sandstone	5,492-5,494	5,575	125	-----	Jan. 15	Pumping.
Baca: Greenwood	No. 1 Mayberry	Midwest Oil Corp.	10	34 S	41 W	Purdy	4,415-4,432	4,886	140	-----	Nov. 4	Pumping; new pay.
Cheyenne: Cheyenne Wells.	No. 1 UPRR-Roth	Mull Drilling Co., Inc.-Bethryn Oil Co.	5	14 S	44 W	Mississippian	5,501-5,511	5,660	90	-----	Oct. 8	Pumping.
Kiowa:												
Quiver	No. 1-2 Owen	Plains Exploration Co.	2	17 S	48 W	do	5,084-5,093	5,359	18	-----	June 20	Do.
Sheridan Lake	No. 1 Baughman Farms-E.	Petroleum, Inc.	32	18 S	44 W	Marmaton	4,364-4,372	5,618	220	-----	Sept. 26	Do.
North Brandon	No. 1 Tallman	Germany Investment Co.	27	18 S	45 W	Mississippian	4,850-4,869	4,995	145	-----	Feb. 17	Do.
La Plata: Wildcat	No. 1-1 Southern Ute-Government.	Empire-Pacific Oil Ltd.	1	32 N	13 W	Graneros-Dakota.	4,056-4,057	4,166	---	627	May 6	Flowing.
Logan:												
Winchester	No. 1 Nelson	Exeter Drilling Co.	2	11 N	53 W	"J" Sandstone	5,348½-5,350	5,460	144	-----	Aug. 2	Pumping.
Wildcat	No. 1 Casement	Frank H. Walsh	7	11 N	54 W	do	5,569-5,574	5,613	40	-----	Nov. 3	Flowing, old well workover.
Moffat:												
Danforth Hills	No. 2 Government-Treleaven.	Texaco Inc.	32	5 N	95 W	Dakota	6,148-6,152	6,766	697	-----	Sept. 1, 1967	Pumping; new pay; old well workover.
Bighole	No. 1 Federal-C	Skelly Oil Co.	22	10 N	94 W	Lewis	7,818-7,856	9,503	---	1,100	Feb. 24	Flowing.
Washington:												
Casino	No. 1 Gilbert	William Sidwell, Jr.-N. M. Tobison-Allison Drilling Co., Inc.	18	2 S	55 W	"J" Sandstone	4,967-4,973	5,060	378	-----	Aug. 21	Do.
Wildcat	No. 1 State	Ray W. Kincaid-Triangle J. Oil Co.	36	3 S	51 W	"D" Sandstone	3,849-3,855	4,020	220	-----	July 17	Pumping.
Caribou	No. 1 Atkinson-Chenoweth.	Enbrook Oil & Gas Co., Inc.	30	3 S	56 W	"J" Sandstone	5,153-5,156	5,230	38	-----	Aug. 14	Do.
Redwing	No. 1 Knutzen	Petroleum, Inc.	3	2 N	52 W	"D" Sandstone	4,601-4,604	4,776	150	-----	Apr. 23	Do.
Weld: Tumbleweed	No. 1 Schroeder	Bill Garber-B W Drilling.	23	12 N	57 W	"J" Sandstone	6,618-6,623	6,675	75	-----	Jan. 16	Do.
	No. 2 Schroeder	Okmar Oil Co.	26	12 N	57 W	"D" Sandstone	6,434-6,437	6,693	150	-----	Nov. 10	Pumping; new pay.

Source: Petroleum Information Corp. 1968 Résumé, Oil and Gas Operations in the Rocky Mountain Region.

The Rangely-Weber reservoir continued to dominate Colorado oil production. Accounting for 46 percent of the State output, it had a cumulative yield at yearend of 416 million barrels of oil. Production from the field was down 1.3 million barrels in 1968.

During the year 48 fluid-injection projects were operative in 45 fields; of these, 45 were waterflood projects, two were combined gas- and water-injection, and one was gas-injection. Four projects commenced injection during the year: Bijou-West, "D" sandstone, December 13; Bobcat, "D" sandstone, April 12; Cache, Ismay, March 12; and Powder Wash, Wasatch, May 29. Three projects ceased operations in 1968: Battle Canyon, "J" sandstone, idle during the year; Jackpot, "D" sandstone, last injection in June; and Swan-Kejr-South Unit, "D" sandstone, in January. The Orchard-West unit, "D" sandstone reservoir, did not operate after February. Total water injected in the projects was 132.9 million barrels (17,130 acre-feet); as would be expected, the Rangely-Weber reservoir received most of the injected water, 74.8 million barrels. The quantities of water mentioned do not differentiate between "new" water and water produced with the oil and reinjected.

Estimates by API and AGA[14] credited the State, as of December 31, 1968, with crude oil reserves of 420.5 million barrels, an increase of 80.6 million barrels, 23.7 percent. Most of the increase (111.4 million barrels) was attributed to revisions and extensions of existing fields; new fields contributed only 1 million barrels. An additional 47.3 million barrels of oil were considered available in known reservoirs by application of fluid injection.

Total drilling activity was down 43 wells from the 538 drilled in 1967. Most of the decline was in development-well drilling; down 13.4 percent from the 261 wells completed in 1967. Exploratory drilling decreased only eight wells, 2.9 percent. The success ratio for wildcat wells, however, was only 7.4 percent, much below the 16.2 percent recorded for 1967 and 12.2 percent for 1966.

Most of the development drilling was in Rio Blanco County—14 of the oil wells were in the Rangely-Weber reservoir and 20 of the gas wells were in the Dragon Trail field. The Border field in Weld County also provided considerable development drilling. Discovered in mid-1967, this field was relatively inactive until late 1967 when a field well was completed for 435 barrels of oil per day. The subsequent drilling program resulted in a total of 20 producing wells; the field moved up to rank fifth in the State. Most of Washington County's development drilling was in the Redwing field which had eight producers by yearend.

Based on initial potential, the most significant discovery of the year was the Casino field in Washington County. The discovery well, William Sidwell, Jr., N. M. Tobison, Allison Drilling Co., Inc., Gilbert No. 1, sec 18, T 2 S, R 55 W, was completed late in the year for a flow gage of 378 barrels of oil per day from the "J" sandstone (Cretaceous). No development drilling had been done by yearend.

The Redwing field also was a significant discovery. Petroleum, Inc., Knutzen No. 1, sec 3, T 2 N, R 52 W, Washington County, was completed for a daily gage of 150 barrels of oil from the "D" sandstone (Cretaceous). By yearend the field had eight wells which had produced 110,554 barrels of oil.

Along the Las Animas Arch in southeastern Colorado, five discoveries caused some leasing and drilling activity in the area. Mull Drilling Co., Inc., and Bethryn Oil Co. discovered the Cheyenne Wells field with their Union Pacific Railroad No. 1 well, sec 5, T 14 S, R 44 W, the first oil discovery in Cheyenne County. The well was completed for a daily gage of 90 barrels of oil and 288 barrels of water from the Mississippian from 5,501 to 5,511 feet.

Germany Investment Co., Tallman No. 1, sec 27, T 18 S, R 45 W, Kiowa County, discovered the North Brandon field. The well was completed for a daily pump gage of 145 barrels of oil from perforations 4,850 to 4,869 feet in the Mississippian.

Petroleum, Inc., discovered the Sheridan Lake field, Kiowa County, 4 miles northeast of the Brandon field. The discovery well, Baughman Farms "E" No. 1, sec 32, T 18 S, R 44 W, was completed for a daily pump gage of 220 barrels of oil.

On the Western Slope the most significant discovery was a new pay zone in the Danforth Hills field, Moffat County. Texaco Inc., Government-Treleaven No. 2, sec 32, T 5 N, R 95 W, was completed pumping 697 barrels of 41° API oil per day from the interval 6,148 to 6,152 feet in the Dakota Formation (Cretaceous). The Dakota is the fourth oil-productive horizon in the Danforth Hills field; other zones are the Weber Formation (Pennsylvanian) and the Morrison and the Entrada Formations (both Jurassic).

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[14] Page 26 of work cited in footnote 10.

The State had four operating refineries, one less than in 1967; the Lubco Oil & Refining Co. plant at Rangely was not operated during the year. The other refineries were Continental Oil Co. and Tenneco Oil Co. at Denver, American Gilsonite Co. at Fruita, and Morrison Refining Co. at Grand Junction. Total refining capacity for the State was 42,900 barrels of crude oil per calendar day, down from the 46,600 barrels for the previous year.

Colorado refineries processed 13.6 million barrels of crude oil; 11.6 million were from out-of-State. Wyoming supplied most of the interstate receipts, 10.2 million barrels; other States shipping oil into Colorado were Montana, New Mexico, and Utah. Out-of-State shipments of crude oil totaled 31 million barrels; of this, 18.4 million went to Utah, 6.7 million to Ohio, and 1.7 million to Kansas. Other States receiving oil from Colorado were Indiana, Oklahoma, Wyoming, Illinois, and Pennsylvania.

NONMETALS

Cement.—Compared with the 1967 shipments, portland cement decreased 10 percent, and masonry cement increased 9 percent. The cements were produced by Ideal Cement Co., a division of Ideal Basic Industries, Inc., at its Boettcher plant in Larimer County and at its Portland plant in Fremont County. Eighty-nine percent of the portland and 94 percent of the masonry cement went to consumers in Colorado; the balance of the shipments went mostly to nearby States. Ready-mixed concrete companies were the biggest customers of portland cement with 70 percent of the total shipments. Other customers, in order of purchases, were concrete-product manufacturers, building-material dealers, highway contractors, other contractors, and miscellaneous customers.

Construction work commenced in April with ground breaking for the $20 million cement plant of Rocky Mountain Cement Co., a subsidiary of Martin Marietta Corp., near Lyons. The company expected the 2.5-million-barrel-per-year cement plant to be in full production by fall 1969.

Clays.—Clay output increased 3 percent in quantity and decreased 4 percent in value. Of the total clay sold and used 60.7 percent was miscellaneous clay and shale, 39.0 percent fire clay, and 0.3 percent bentonite; in 1967, the percentages were 75.8, 23.9, and 0.3, respectively. About three-fourths of the output of clay was captive production; the balance was produced and sold as raw material.

Clay was produced by 24 companies from 53 operations. Two companies mined bentonite; 15 companies, fire clay; six companies, miscellaneous clay and shale; and one company, fire clay and miscel-

Table 16.—Clay production by counties

County	1967		1968	
	Short tons	Value	Short tons	Value
Bent	173	$868	-----------	-----------
Boulder	15,864	31,132	11,178	$20,558
Custer	W	W	-----------	-----------
Douglas	40,107	105,000	67,526	126,887
Elbert	W	W	W	W
El Paso	W	W	W	W
Fremont	33,396	93,861	23,018	68,286
Huerfano	W	W	W	W
Jefferson	409,639	560,114	404,429	566,461
Las Animas	W	W	W	W
Pueblo	60,081	373,748	55,925	342,518
Saguache	-----------	-----------	985	6,895
Undistributed	37,238	108,976	53,175	90,338
Total	596,498	1,273,699	616,236	1,221,938

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

laneous clay and shale. The Idealite Co., a division of Ideal Cement Co., the largest producer, mined shale in Jefferson County for making lightweight aggregate. Ten counties had clay output during 1968. Jefferson County, with almost two-thirds of the State's output, was the leading county.

Bentonite was used for lining reservoir ponds. Fire clay was used for making heavy clay products (building brick and sewer pipe) and refractories (firebrick, lining ladles, and foundry uses). More than half of the output of miscellaneous clay and shale was used for making lightweight aggregate; other uses were for making building brick, firebrick, cement, and pottery.

Feldspar.—Feldspar was produced only by Lockhardt & Sons; the output, a slight increase of 4 tons over that of 1967, came from the Mica Lode mine in Fremont County and was sold for use in making decorative aggregate.

Fluorspar.—Output of fluorspar, up 25 percent, came from three mines located in Boulder, Fremont, and Jackson Counties. Except for a small quantity of fluxing gravel used for steelmaking, the product was acid-grade used for making hydrofluoric acid.

Because of a new market, Allied Chemical Corp. increased operations at its Burlington mine at Jamestown for producing acid-grade fluorspar. The mine went on two 8-hour shifts; and the mill was operated on a 24-hour schedule, 7 days per week, at full production capacity.

Inactive since 1959, except for stockpile shipments through 1963, the Northgate mine of Ozark-Mahoning Co. at Cowdrey was placed in operation; development work and mining by shrinkage stoping got under way.

Gypsum.—Gypsum production increased 21,000 tons, 27 percent over that of 1967. The output came from six mines—three in Fremont County and one each in Chaffee, Douglas, and Larimer Counties. Part of the output was calcined and then used in manufacturing gypsum building products. Uncalcined gypsum was used as a portland-cement retarder and as a soil conditioner.

Johns-Manville Corp. acquired the gypsum operation of Fibreboard Corp. in Fremont County consisting of a mine near Coaldale and the wallboard plant at Florence.

Lime.—Lime output, up 7,000 tons from 1967, came from the same 13 plants that were operated last year.

Although lime used for soil stabilization in construction work decreased 6,700 tons, the increase of 12,800 tons used in sugar refining was more than enough to offset this decline. Ten of the 13 lime plants were at sugar beet facilities. The Great Western Sugar Co. had eight plants; Holly Sugar Corp. and American Crystal Sugar Co., one each.

Lime produced at the Pueblo steel mill of CF&I was used either for refractory purposes or for producing slag during the basic-oxygen steelmaking process. The output of lime produced by Basic Chemical Corp. at its plant in Glenwood Springs was sold for metallurgical purposes, water treatment, and sewage and industrial waste treatment. Lime produced by Colorado Lime Co., Inc., at its Colorado Springs plant was used as a soil conditioner and for sewage and industrial waste treatment.

CF&I built and placed into operation a new 300-ton-per-day limekiln to provide high-quality lime for the company's two 115-ton-capacity basic-oxygen steel furnaces in Pueblo. Steel made by the basic-oxygen process uses up to 150 pounds of lime per ingot ton of steel. The new kiln, designed and engineered by the Mining and Metals Division of Union Carbide Corp., is a proprietary vertical type, capable of high production rates at low operating costs. It also has a high degree of flexibility by being able to operate as low as 150 tons per day without any appreciable change in lime quality or fuel efficiency.

Perlite.—Crude perlite was mined by Persolite Products, Inc., at its operation at Rosita. The quantity sold and used was 43 percent greater than in 1967; most of the product was sent to the company's expanding plant at Florence where it was expanded and then sold for use in soil conditioning, as loose fill insulation, aggregate in building plaster and concrete, and fire base material.

Building Products Division, Grefco, Inc., expanded crude perlite at its Antonito plant for use as filler and filter aid. At its expanding plant in Denver, Zonolite Division—Western Region, W. R. Grace & Co., expanded crude perlite for use in soil conditioning, as loose-fill insulation, an aggregate in building plaster and concrete, and textured granules. Crude perlite used at the expanding plants of Grefco and W. R. Grace came from deposits in New Mexico.

Pumice.—The output of pumice, consisting of scoria and volcanic cinders, increased 10,000 tons. Volcanic cinders were mined by Dotsero Block Co., Inc., and Roaring Fork Pumice Block Co. in Eagle County and by Volcanic Materials, Inc., in Saguache County. Scoria was mined by Colorado Aggregates Co., Inc., in Costilla County and by McCoy Aggregate Co. in Routt County. Seventy-three percent of the pumice material was used as concrete aggregate. Other uses were for cat litter, cleaning and scouring compounds including hand soap, landscaping, lining for barbecue grills, roadbuilding, rock gardens, and roofing.

Pyrites.—Climax Molybdenum Co., the only producer of pyrite, recovered it as a byproduct of molybdenum ore milled at the Climax mine. Most of the pyrite was sold and used for manufacturing sulfuric acid and the balance as a coloring ingredient for making brown glass bottles.

Salt.—Salt production, slightly below that of 1967, was obtained as a brine pumped from a well in Montrose County by Union Carbide Corp.; the brine was used in the company's uranium-vanadium mill at Uravan.

Sand and Gravel.—Sand and gravel sold and used, up 6 percent, surpassed the 23-million-ton mark for the first time. The value of output was greater than that of all the other nonmetallic commodities combined and represented 7 percent of the total value of the State's mineral production.

Eighty percent of the sand and gravel output was gravel; 20 percent was sand. The average price for gravel was $1.12 per ton; that for sand was $1.27. The overall average for sand and gravel was $1.15 per ton. Only 892,000 tons of sand and gravel were unprocessed or pit-run material. The balance—22.2 million tons—was either washed, crushed, screened, or combinations thereof. The average price for pit-run sand and gravel was $0.52 per ton and that for processed $1.18.

Table 17.—Sand and gravel production in 1968, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Adams	3,401	$3,695	Larimer	1,098	$1,177
Alamosa	664	489	Las Animas	781	804
Arapahoe	1,212	1,391	Lincoln	370	358
Archuleta	180	170	Logan	850	856
Baca	128	135	Mesa	722	834
Bent	64	64	Mineral	3	3
Boulder	1,244	1,314	Moffat	264	259
Chaffee	307	325	Montezuma	291	350
Cheyenne	14	9	Montrose	192	180
Clear Creek	W	W	Morgan	301	337
Conejos	86	95	Otero	W	W
Costilla	W	W	Ouray	49	35
Crowley	6	3	Phillips	74	85
Custer	55	48	Pitkin	212	245
Delta	249	300	Prowers	144	176
Dolores	120	120	Pueblo	1,032	1,646
Douglas	435	500	Rio Blanco	174	179
Eagle	81	87	Rio Grande	126	145
Elbert	W	W	Routt	W	W
El Paso	1,550	2,114	Saguache	W	W
Fremont	303	313	San Juan	25	25
Garfield	178	247	San Miguel	42	42
Grand	69	76	Sedgwick	74	66
Gunnison	373	359	Summit	147	164
Hinsdale	(1)	(1)	Teller	27	23
Huerfano	26	26	Washington	106	105
Jefferson	2,407	3,588	Weld	699	699
Kiowa	136	134	Yuma	258	256
Kit Carson	485	497	Undistributed	804	869
Lake	352	390			
La Plata	181	251	Total	23,121	26,608

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Less than ½ unit.

Table 18.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	2,072	$2,364	2,321	$2,605
Paving	385	487	628	1,573
Railroad ballast	[1] 19	[1] 24	[2] 100	[2] 162
Fill	329	328	142	100
Other	(1)	(1)	(2)	(2)
Industrial:				
Blast	3	11	(2)	(2)
Fire or furnace	(1)	(1)	(2)	(2)
Engine	8	30	(2)	(2)
Filtration	--------	--------	(2)	(2)
Total	2,816	3,244	3,191	4,440
Gravel:				
Construction:				
Building	2,353	3,132	2,555	3,699
Paving	5,144	5,640	5,427	6,779
Railroad ballast	24	22	97	180
Fill	452	298	312	254
Other	--------	--------	290	346
Miscellaneous	318	416	95	112
Total	8,291	9,508	8,776	11,870
Total sand and gravel	11,107	12,752	11,967	15,810
Government-and-contractor operations:				
Sand:				
Building	186	209	1	1
Paving	739	711	1,365	1,373
Fill	55	61	101	101
Other	1	1	16	14
Total	981	982	1,483	1,489
Gravel:				
Building	518	527	--------	--------
Paving	7,146	6,775	8,677	8,632
Fill	2,054	1,866	985	671
Other	4	2	9	6
Total	9,722	9,170	9,671	9,309
Total sand and gravel	10,703	[3] 10,150	11,154	10,798
All operations:				
Sand	3,797	4,226	4,674	5,929
Gravel	18,013	18,678	18,447	20,679
Total	21,810	22,904	23,121	26,608

[1] Railroad ballast, "Other (construction)," and fire or furnace sand combined to avoid disclosing individual company confidential data.
[2] Railroad ballast, "Other (construction)," blast, fire or furnace, engine and filtration sand combined to avoid disclosing individual company confidential data.
[3] Data may not add to totals shown because of independent rounding.

Commercial operators shipped 12.0 million tons, 52 percent of the total output of sand and gravel. Those with shipments exceeding 500,000 tons, in order of quantity, were Cooley Gravel Co.; The Brannan Sand & Gravel Co.; Western Paving Construction Co.; Broderick and Gibbons, Inc.; Pre-Mix Sand & Gravel Division, Pre-Mix Concrete, Inc.; and Asphalt Paving Co. Output of these six companies totaled 4.9 million tons. Noncommercial output—that produced for Governmental agencies, either by contractors or Government crews—was 11.2 million tons, 48 percent of total output of sand and gravel. Of 355 operations, 150 were classed as commercial and 205 as Government-and-contractor.

Sand and gravel used for road construction and maintenance was 16.1 million tons and that for building construction 4.9 million tons. The balance of 2.1 million tons was used as industrial sand—blast, engine, filtration, and fire and furnace—and for fill, railroad ballast, and miscellaneous uses.

Denver, Gilpin, Jackson, and Park Counties did not have any sand and gravel attributed to them. Of the 59 counties with output, 42 had commercial operations and all but one, Routt County, had Government-and-contractor operations. Seven counties—Adams, Jefferson, El Paso, Boulder, Arapahoe, Larimer, and Pueblo, ranked according to quantity—had output exceeding 1 million tons; their combined output was 11.9 million tons, 52 percent of the State output. Thirty-three counties had output between 100,000 tons and 1 million tons; 19 had less than 100,000 tons.

Stone.—Stone output decreased 521,000 tons, 17 percent below that of 1967. Stone was quarried at 132 operations in 40 counties. Fremont County had the largest amount with 910,630 tons. Four other counties with quantities greater than 100,000 tons, in order of output, were Larimer, Chaffee, Gunnison, and El Paso.

Except for 12,200 tons of dimension stone, the output was crushed and broken stone. The principal uses for crushed and broken stone, ranked according to quantity (100,000 tons or more) were for making cement; as flux stone, riprap, road base aggregate, and concrete aggregate; for making lime; and as surface treatment aggregate. The kinds of stone quarried during 1968 were as follows: Limestone, including dolomite, 73.3 percent of the State output; sandstone, including quartzite, 10.2 percent; granite, 8.2 percent; marble, 0.1 percent; and miscellaneous (unclassified) stone, 8.2 percent.

The leading stone producers, with output of 100,000 tons or more, ranked according to the amount sold and used, were Ideal Cement Co. (limestone and sandstone), CF&I (limestone and dolomite), Castle Concrete Co. (limestone), Gunnison County Highway Department (limestone and granite), and Frank H. Norberg Co. (limestone).

Sulfur.—At its Denver oil refinery Continental Oil Co. constructed and placed in operation a $6.5 million sulfur recovery unit having a daily capacity of 18 long tons of sulfur. The output was not included as part of the mineral production of the State because it is considered a secondary product.

Vermiculite.—Exfoliated at the Denver plant of W. R. Grace & Co., crude vermiculite came from the company's vermiculite mining operation in Montana. The exfoliated vermiculite was sold for use as loose-fill insulation, concrete and building-plaster aggregate, fire-base material, and for agricultural purposes.

Table 19.—Stone production in 1968, by counties

County	Short tons	Value	County	Short tons	Value
Adams	497	$746	Las Animas	40,569	$60,854
Arapahoe	2,300	4,010	Lincoln	1,192	1,788
Archuleta	646	969	Logan	1,800	2,160
Baca	94	141	Mesa	W	W
Boulder	97,225	190,468	Montrose	23,965	113,834
Chaffee	W	W	Otero	317	476
Conejos	W	W	Park	W	W
Custer	W	W	Phillips	132	198
Dolores	23,151	46,326	Pitkin	330	495
Douglas	W	W	Pueblo	W	W
Eagle	28,688	25,017	Rio Blanco	1,782	2,673
El Paso	W	W	Rio Grande	88,734	131,286
Fremont	910,630	1,490,684	Routt	1,782	2,673
Garfield	61,682	203,907	Sedgwick	750	750
Grand	420	630	Summit	448	537
Gunnison	203,952	407,828	Teller	644	12,880
Hinsdale	1,512	3,024	Washington	1,500	9,450
Huerfano	10	15	Weld	2,913	9,884
Jefferson	23,552	99,091	Undistributed	443,680	993,987
Kit Carson	715	1,072			
Lake	13,876	22,458	Total	2,471,424	5,201,461
Larimer	496,986	1,361,150			

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Table 20.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Kind of stone	1964		1965		1966		1967		1968	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Dolomite and limestone	2,273	$4,413	2,204	$4,067	2,191	$3,911	[1] 2,214	[1] $3,823	1,812	$3,694
Granite	483	859	2,059	3,089	2,789	4,358	284	418	202	470
Marble	10	73	2	33	3	35	3	26	1	12
Quartz, quartzite, and sandstone	95	734	189	833	1,664	2,443	281	847	252	615
Quartz and quartzite	NA	NA	NA	NA	NA	NA	NA	NA	72	162
Sandstone	NA	NA	NA	NA	NA	NA	NA	NA	180	453
Traprock	6	6	W	W	45	48	W	W	------	-------
Other stone	350	722	335	616	338	536	211	370	204	410
Total [2]	3,217	6,805	4,789	8,638	7,031	11,331	2,992	5,485	2,471	5,201

NA Not available.

W Withheld to avoid disclosing individual company confidential data; included with "Other stone."

[1] Excludes dimension limestone which is included with "Other stone."

[2] Data may not add to totals shown because of independent rounding.

Table 21.—Stone sold or used by producers, by uses

Use	1967		1968	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough:				
Construction and rubble short tons	5,786	$61,409	1,743	$16,456
Architectural cubic feet	28,394	38,189	32,622	29,085
Monumental do	8,810	12,860	6,962	12,880
Other do	----------	----------	31,373	36,854
Dressed:				
Architectural cubic feet	37,932	85,424	43,792	96,281
Monumental do	5,000	28,980	5,000	100,000
Flagging do	40,573	41,244	8,451	10,258
Total (approximate) short tons	15,300	268,056	12,200	301,264
Crushed and broken stone:				
Concrete and roadstone short tons	765,826	1,085,532	[1] 569,718	[1] 1,129,917
Bituminous aggregate do	NA	NA	W	W
Concrete aggregate do	NA	NA	204,012	446,668
Dense graded roadbase do	NA	NA	219,966	371,229
Surface treatment aggregates do	NA	NA	145,740	312,020
Lime do	154,772	357,611	174,873	423,053
Metallurgical do	302,682	704,440	W	W
Riprap and jetty stone do	370,155	624,973	258,963	469,486
Other do	[2] 1,383,541	[2] 2,444,443	[3] 1,455,670	[3] 2,877,741
Total do	2,976,976	5,216,999	2,459,224	4,900,197
Total stone (approximate) do	2,992,300	5,485,055	2,471,400	5,201,461

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Other."

[1] Subdivided in 1968 into concrete aggregate and various roadstone aggregates; bituminous aggregate withheld to avoid disclosing individual company confidential data; included with "Other."

[2] Includes stone used in aggregate facings, aggregates, agriculture, asphalt filler, cement, coal dust, filter media, foundry, landscaping, mineral food, precasting, and terrazzo.

[3] Includes stone used in asphalt fillers, cement, landscaping, manufactured fine aggregate, mine dusting, other soil conditioners and nutrients, railroad ballast, refractories, and terrazzo and exposed aggregate.

Table 22.—Principal producers

Commodity and company	Address	Type of activity	County
Beryllium: U.S. Beryllium Corp.	306 Bon Durant Bldg. Pueblo, Colo. 81003	Open-pit mine and mill	Park.
Carbon dioxide, natural: Tenneco Oil Co.	Box 1714 Durango, Colo. 81301	Well	Do.
Cement: Ideal Cement Co., a division of Ideal Basic Industries, Inc.	620 Ideal Cement Bldg. Denver, Colo. 80202	Wet-process, 2-rotary-kiln plant.	Fremont.
		Dry-process, 2-rotary-kiln plant.	Larimer.
Clays:			
The Idealite Co., a division of Ideal Cement Co.	420 Ideal Cement Bldg. Denver, Colo. 80202	Open pit mine and expanding plant.	Jefferson.
Robinson Brick & Tile Co.	500 S. Santa Fe Drive Denver, Colo. 80223	Underground mine and 3 open pit mines.	Douglas.
Coal, bituminous:			
CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	Underground mine	Las Animas.
Clayton Coal Co	616 Denham Bldg. Denver, Colo. 80202	Underground mine and crushing plant.	Weld.
Energy Coal Co	2850 N. Meridian Street Indianapolis, Ind. 46208	Strip mine and crushing plant.	Routt.
The Imperial Coal Co	1010 Western Federal Savings Bldg. Denver, Colo. 80202	2 underground mines; cleaning, crushing, and oil treatment plant.	Weld.
Mid-Continent Coal and Coke Co.	Carbondale, Colo. 81623	2 underground mines	Pitkin.
Peabody Coal Co	301 N. Memorial Drive St. Louis, Mo. 63102	Strip mine and crushing plant.	Montrose.
		----do	Routt.
The Pittsburg & Midway Coal Mining Co.	Ten Main Center Kansas City, Mo. 64105	Strip mine; crushing and oil treatment plant.	Do.
United States Steel Corp. Western District—Coal.	Box 807 Dragerton, Utah 84520	Underground mine and crushing plant.	Delta and Gunnison.
Copper: Idarado Mining Co	Ouray, Colo. 81427	*See* Zinc	Ouray and San Miguel.
Fluorspar: Allied Chemical Corp., Industrial Chemicals Division.	Box 70 Morristown, N. J. 07960	Underground mine and plant.	Boulder.
Gold:			
Idarado Mining Co	Ouray, Colo. 81427	*See* Zinc	Ouray and San Miguel.
Standard Metals Corp	415 Petroleum Club Bldg. 110 16th Street Denver, Colo. 80202	----do	San Juan.
Gypsum: Johns-Manville Corp. (formerly Fibreboard Corp.)	215 Market Street, Room 916 San Francisco, Calif. 94105	Open pit mine and wallboard plant.	Fremont.
Iron ore: Pitkin Iron Corp	105 W. Adams Street Chicago, Ill. 60603	Open-pit mine	San Juan.
Lead:			
Emperius Mining Co	Creede, Colo. 81130	Underground mine and mill.	Mineral.
Idarado Mining Co	Ouray, Colo. 81427	*See* Zinc	Ouray and San Miguel.
The New Jersey Zinc Co	160 Front Street New York, N.Y. 10038	----do	Eagle.
Rico Argentine Mining Co.	605 Kearns Bldg. Salt Lake City, Utah 84118	----do	Dolores.
Standard Metals Corp	415 Petroleum Club Bldg. 110 16th Street Denver, Colo. 80202	----do	San Juan.
Lime:			
The Great Western Sugar Co.	Box 5308 Denver, Colo. 80217	1-shaft-kiln plant	Adams.
		2-shaft-kiln plant	Boulder.
		----do	Larimer.
		1-shaft-kiln plant	Logan.
		----do	Morgan.
		----do	Sedgwick.
		2 one-shaft kiln plants	Weld.
CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	Natural-frequency-vibrating kiln plant.	Pueblo.
Molybdenum: American Metal Climax, Inc., Climax Molybdenum Co.	1270 Avenue of the Americas New York, N.Y. 10020	Underground mine and mill.	Clear Creek.
		Underground mine, mill, molybdic oxide plant, and by-products plant.	Lake.

Table 22.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Natural gas and petroleum:[1]			
Bright & Schiff	107 Mercantile Continental Bldg. Dallas, Tex. 75201	Crude oil and gas wells: Saber field.	Logan.
Champlin Petroleum Co	Box 9365 Fort Worth, Tex. 76107	Crude oil and gas wells: Boxer field.	Morgan.
		Crude oil and gas wells: Bison, Ramp, and Westfork fields.	Washington.
Chevron Oil Co., Western Division.	Box 599 Denver, Colo. 80201	Crude oil and gas wells: Black Hollow and Pierce fields.	Weld.
		Crude oil and gas wells, and gas processing plant: Rangely field.	Rio Blanco.
Continental Oil Co	Box 2197 Houston, Tex. 77001	Crude oil and gas wells: McCallum field.	Jackson.
		Crude oil and gas wells, and gas processing plant: Big Beaver, Bobcat, Little Beaver, and Plum Bush Creek fields.	Washington.
		Refinery	Adams.
Gulf Oil Corp	Gulf Bldg. Pittsburgh, Pa. 15219	Crude oil and gas wells: Northwest Graylin, Lewis Creek, West Peetz, and Yenter fields.	Logan.
Monsanto Co., Hydrocarbons & Polymers Division.	800 N. Lindbergh Boulevard St. Louis, Mo. 63116	Crude oil wells: Battleship field.	Jackson.
		Crude oil and gas wells: Marble Wash field.	Montezuma.
		Crude oil and gas wells: Little East Beaver and Nugget fields.	Washington.
Okmar Oil Co	Box 548 Marietta, Ohio 45750	Crude oil wells: Bison field.	Do.
Pan American Petroleum Corp.	Box 591 Tulsa, Okla. 74101	Crude oil and gas wells: Black Jack field.	Arapahoe.
		Crude oil and gas wells: Cache field.	Montezuma.
		Crude oil and gas wells: Big Beaver field.	Washington.
R. E. Hibbert Oil Properties.	1142 Houston Club Bldg. Houston, Tex. 77002	Crude oil and gas wells: Cody and Monte fields.	Do.
Shell Oil Co	50 W. 50th Street New York, N.Y. 10020	Crude oil and gas wells: Divide and Mount Hope fields.	Logan.
Sinclair Oil & Gas Co	Box 521 Tulsa, Okla. 74102	Crude oil and gas wells: Cliff and West Padroni fields.	Do.
Stuarco Oil Co., Inc	2117 First National Bank Bldg. Denver, Colo. 80202	Crude oil and gas wells: Bonanza field.	Do.
		Crude oil and gas wells: Boots Hill field.	Morgan.
		Crude oil and gas wells: Cody field.	Washington.
Tenneco Oil Co	E. 16th Avenue & Grant Street Denver, Colo. 80203	Refinery	Adams.
Texaco Inc	1570 Grant Street Denver, Colo. 80203	Crude oil and gas wells: Danford and Mauldin Gulch fields.	Moffat.
		Crude oil and gas wells and gas processing plant: Wilson Creek field.	Rio Blanco.
Union Oil Company of California, Northern Division.	1700 Broadway Denver, Colo. 80210	Crude oil and gas wells and gas processing plant: Adena field.	Morgan.
Union Texas Petroleum Corp.	Box 2120 Houston, Tex. 76101	Crude oil wells: Blade, Lindon, Ranger, Ring, and Rush Willadel fields.	Washington.

See footnote at end of table.

Table 22.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Peat:			
Alpen Meadows, Inc.	Box 1074 Colorado Springs, Colo. 80901	Bog	Teller.
McCoy & Jensen	9800 Morrison Road Morrison, Colo. 80465	Bog	Boulder.
Mountain States Fertilizer & Landscape, Inc.	2920 Pearl Street Boulder, Colo. 80302	Bog	Boulder.
		Bog	Park.
Clarence C. Reiff	109 E. Eagle Avenue Kremmling, Colo. 80459	Bog	Lake.
Perlite: Persolite Products, Inc.	1440 W. 13th Avenue Denver, Colo. 80204	Open pit mine	Custer.
		Expanding plant	Fremont.
Pumice:			
Colorado Aggregate Co., Inc.	Mesita, Colo. 81142	Open pit mine and plant.	Costilla.
Dotsero Block Co., Inc.	Box 933 Glenwood Springs, Colo. 81601	do	Eagle.
McCoy Aggregate Co.	703 Lincoln Avenue Steamboat Springs, Colo. 80477	do	Routt.
Pyrites: American Metal Climax, Inc., Climax Molybdenum Co.	1270 Avenue of the Americas New York, N.Y. 10020	*See* Molybdenum	Lake.
Rare-earths, monazite: American Metal Climax, Inc., Climax Molybdenum Co.		do	Do.
Sand and gravel (commercial):			
Asphalt Paving Co.	14802 W. 44th Avenue Golden, Colo. 80401	Pit and plant	Douglas.
		Pit and 2 plants	Jefferson.
		2 pits and plants	Pueblo.
The Brannan Sand & Gravel Co.	4800 Brighton Blvd. Denver, Colo. 80216	5 pits and plants	Adams.
		Pit and plant	Arapahoe.
		2 pits and plants	Jefferson.
Broderick & Gibbons, Inc.	Box 313 Pueblo, Colo. 81002	5 pits and plant	El Paso.
		7 pits and plant	Pueblo.
Cooley Gravel Co.	5631 Tennyson Street Arvada, Colo. 80002	2 pits and plants	Adams.
		do	Arapahoe.
Pre-Mix Concrete, Inc., Pre-Mix Sand & Gravel Division.	1500 W. 12th Avenue Denver, Colo. 80204	Pit and plant	Adams.
		do	Douglas.
Western Paving Construction Co.	5105 Washington Street Denver, Colo. 80216	3 pits and plant	Adams.
		Pit	Boulder.
		Pit and plant	Jefferson.
Silver:			
American Smelting and Refining Co. (McFarland & Hullinger, lessee.)	120 Broadway New York, N.Y. 10005	Shipped from stockpile.	Gunnison.
Emperius Mining Co.	Creede, Colo. 81130	*See* Lead	Mineral.
Federal Resources Corp. (Camp Bird Colo., Inc., operator.)	1370 South 3d West Salt Lake City, Utah 84115	Underground mine and mill.	Ouray.
Idarado Mining Co.	Ouray, Colo. 81427	*See* Zinc	Ouray and San Miguel.
The New Jersey Zinc Co.	160 Front Street New York, N.Y. 10038	do	Eagle.
Rico Argentine Mining Co.	605 Kearns Bldg. Salt Lake City, Utah 84118	do	Dolores.
Standard Metals Corp.	415 Petroleum Club Bldg. 110 16th Street Denver, Colo. 80202	do	San Juan.
White Rock Aggregate & Mining Co.	15981 West 3d Place Golden, Colo. 80401	Underground mine	Clear Creek.
Stone:			
Castle Concrete Co.	Box 2379 Colorado Springs, Colo. 80901	2 quarries and plants	El Paso.
		Quarry and plant	Fremont.
CF&I Steel Corp.	Box 316 Pueblo, Colo. 81002	do	Chaffee.
		do	Fremont.
Frank H. Norberg Co.	418 Guaranty Bank Bldg. Denver, Colo. 80202	do	Garfield.
		2 quarries and plants	Larimer.
Gunnison County Highway Department.	Gunnison, Colo. 81230	2 quarries and plant	Gunnison.
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	620 Ideal Cement Bldg. Denver, Colo. 80202	Quarry and plant	Fremont.
		do	Larimer.
Tin: American Metal Climax, Inc., Climax Molybdenum Co.	1270 Avenue of the Americas New York, N.Y. 10020	*See* Molybdenum	Lake.
Tungsten: American Metal Climax, Inc., Climax Molybdenum Co.		do	Do.

See footnote at end of table.

Table 22.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Uranium:			
American Metal Climax, Inc., Climax Uranium Co.	Box 1629	9 underground mines and mill.	Mesa.
	Grand Junction, Colo. 81501	15 underground mines	Montrose.
Cotter Corp	Box 751	6 underground mines	San Miguel.
	Canon City, Colo. 81212	Underground mine	Jefferson.
		Mill	Fremont.
Foote Mineral Co	200 Park Avenue	Underground mine	Mesa.
	New York, N.Y. 10017	23 underground mines	Montrose.
		5 underground mines	San Miguel.
Union Carbide Corp	270 Park Avenue	2 underground mines and mill.	Garfield.
	New York, N.Y. 10017	16 underground mines	Mesa.
		78 underground mines and mill.	Montrose.
		9 underground mines	San Miguel.
Vanadium:			
American Metal Climax, Inc., Climax Uranium Co.	Box 1629 Grand Junction, Colo. 81501	*See* Uranium	Mesa, Montrose, San Miguel.
Union Carbide Corp	270 Park Avenue New York, N.Y. 10017	do	Garfield, Mesa, Montrose, San Miguel.
Zinc:			
Emperius Mining Co	Creede, Colo. 81130	*See* Lead	Mineral.
Idarado Mining Co	Ouray, Colo. 81427	Underground mine and mill.	Ouray and San Miguel.
The New Jersey Zinc Co	160 Front Street New York, N.Y. 10038	do	Eagle.
Rico Argentine Mining Co.	605 Kearns Bldg. Salt Lake City, Utah 84118	do	Dolores.
Standard Metals Corp	415 Petroleum Club Bldg. 110 16th Street Denver, Colo. 80202	3 underground mines and mill.	San Juan.

[1] Principal producers in the major fields.

The Mineral Industry of Connecticut

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Connecticut Geological and Natural History Survey for collecting information on all minerals except fuels.

By Eugene C. Baker [1]

Mineral production in Connecticut was valued at $23.9 million in 1968, about 16 percent higher than in 1967. Greater sales of stone, sand and gravel, lime, and mica accounted for value increase. The combined production of these commodities was up about 13 percent.

Sand and gravel and stone continued to be the principal minerals produced in the State with respective increases of 5 and 25 percent that were attributed to greater building and road construction activity.

Hartford County mineral value was the greatest in the State, followed in order of magnitude by New Haven, Litchfield, Middlesex, New London, Fairfield, Windham, and Tolland Counties.

The Connecticut Geological and Natural History Survey in cooperation with the U.S. Geological Survey published surficial geology of the Danielson, Ashaway, Norwalk South, West Torrington, Durham and New Preston Quadrangles. In addition, the Connecticut Survey published a surficial geologic map of the Ansonia and Milford Quadrangles and the bedrock geology of the Long Hill and Bridgeport Quadrangles; geology of the Springfield South Quadrangle and bedrock geology of the Danielson and Meriden, and Aeromagnetic maps of Hampden, Monson, Southbridge, Springfield South, Wales, Webster, West Springfield, and part of the Southwick Quadrangles.

Table 1.—Mineral production in Connecticut [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays____thousand short tons__	191	$334	195	$325
Gem stones____	NA	8	NA	8
Sand and gravel____thousand short tons__	8,320	8,710	8,752	9,321
Stone____do____	5,097	10,141	6,383	12,729
Value of items that cannot be disclosed: Feldspar, lime, and mica (scrap)____	XX	1,426	XX	1,493
Total____	XX	20,619	XX	23,876
Total, 1957–59 constant dollars____	XX	19,807	XX	p 22,683

p Preliminary. NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

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[1] Industry economist, Bureau of Mines, Pittsburgh, Pa.

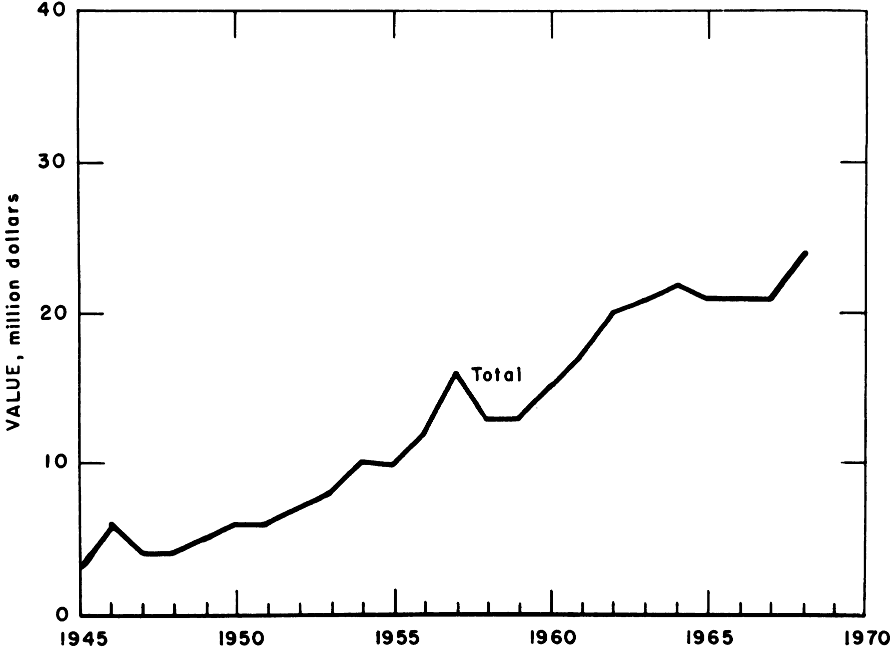

Figure 1.—Value of mineral production in Connecticut.

Table 2.—Value of mineral production in Connecticut, by counties

(Thousand dollars)

County	1967	1968	Minerals produced in 1968 in order of value
Fairfield	$1,092	$976	Sand and gravel.
Hartford	6,189	8,497	Stone, sand and gravel, clays.
Litchfield	2,207	2,781	Stone, sand and gravel, lime.
Middlesex	1,656	1,514	Feldspar, sand and gravel, stone, mica, clays.
New Haven	6,053	7,186	Stone, sand and gravel, clays.
New London	1,265	1,096	Stone, sand and gravel.
Tolland	W	W	Sand and gravel.
Windham	W	W	Stone, sand and gravel.
Undistributed [1]	2,157	1,825	
Total [2]	20,619	23,876	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes sand and gravel and gem stones that cannot be assigned to specific counties, and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Connecticut business activity

	1967	1968	Change (percent)
Employment:			
Total labor force——thousands	1,294	1,330	+2.8
Manufacturing——do	480	477	−6.3
Durable goods——do	360	356	−1.1
Nondurable goods——do	120	121	+.8
Nonagricultural——do	1,130	1,150	+1.8
Unemployment——percent of work force	3.3	3.7	+12.1
Personal income:			
Total——millions	$11,609	$12,537	+8.1
Per capita	$3,978	p $4,231	+6.4
Construction activity:			
New building permits	1,747	2,060	+17.9
Cement shipments to and within Connecticut thousand 376-pound barrels	3,695	4,313	+16.7
Business activity:			
New incorporations	262	287	+9.5
Electric power sales——million kilowatt-hours	392	417	+6.4
Mineral production——thousands	$20,619	$23,876	+15.8

p Preliminary.
Source: U.S. Department of Labor, Bureau of Employment Security; U.S. Department of Commerce; and Connecticut Labor Department.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1967:								
Nonmetal	135	272	37	302	-------	4	13.25	172
Sand and gravel	520	211	110	896	-------	14	15.62	594
Stone	368	241	89	772	1	13	18.14	8,197
Total	1,023	230	235	1,970	1	31	16.25	3,508
1968:p								
Nonmetal	140	283	39	314	-------	10	31.86	335
Sand and gravel	455	212	97	785	-------	11	14.02	516
Stone	385	275	106	888	-------	20	22.53	550
Total	980	247	241	1,986	-------	41	20.64	502

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—There were no manufacturers of cement in the State. Shipments of portland cement into Connecticut amounted to 4.3 million barrels; masonry cement shipments from other States were 145,000 barrels. These figures reflect an increase of approximately 16 percent for portland cement, while masonry cement remained about the same as 1967.

Clays.—Clay was recovered in Hartford, Middlesex, and New Haven Counties by four companies. The quantity produced was 2 percent greater than that of 1967, but the total value decreased about 3 percent, because of a lower unit price.

Most of the clay was consumed in the manufacture of building brick; small quantities were utilized by the ceramic and specialty clay products industry.

Feldspar.—Production of crude feldspar in Middlesex County was about 11 percent less than that of 1967. One mine was abandoned during the year, and one mine recovered feldspar by flotation. Glass and ceramic manufacturers in New Jersey, Pennsylvania, and Rhode Island were the principal buyers. Limited quantities were exported.

Gem Stones.—The value of recovered gem stones was estimated to be about the same as that of 1967. Mineralogical societies, dealers, and individuals collected the stones from dumps, quarries, and pegmatite deposits in the State.

Gypsum.—National Gypsum Co. produced calcined gypsum at its New Haven plant for use in manufacturing finished building materials. The plant's crude supply was shipped from out of State.

Lime.—Production and value of lime, quick and hydrated, increased 20 percent and 19 percent, respectively, compared with that of 1967. Quicklime and hydrated lime were produced at Canaan by Minerals, Pigments, & Metals Division of Charles Pfizer & Co., Inc., from limestone quarried nearby. Most of the quicklime was sold to processors of calcium metal and for use in paper manufacture. The hydrated lime was marketed primarily for use in masonry construction; some was sold for agricultural lime.

Mica.—The State had one producer of mica which was recovered as a byproduct from a feldspar flotation plant in Middlesex County. The mica was sold to producers of roofing material.

Sand and Gravel.—The combined production and value of commercial and Government-and-contractor sand and gravel increased for the first time since 1964.

Combined production was about 8.8 million tons, up some 5 percent from that of 1967. Of this quantity, about 87 percent was sold commercially, and 13 percent was utilized by Government-and-contractor operations. The value of the combined pro-

Table 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967 Quantity	1967 Value	1968 Quantity	1968 Value
Commercial operations:				
Sand:				
Structural	1,707	$2,063	2,054	$2,306
Paving	1,476	1,632	1,630	2,035
Fill	393	236	413	246
Other [1]	317	339	186	178
Total	3,893	4,270	4,283	4,765
Gravel:				
Structural	1,288	2,316	1,504	2,446
Paving	794	981	886	1,039
Fill	407	210	712	342
Other [2]	236	278	194	246
Total	2,725	3,785	3,296	4,073
Total sand and gravel	6,618	8,055	7,579	8,838
Government-and-contractor operations:				
Sand:				
Paving	194	73	183	72
Fill	-----	-------	30	20
Other	40	25	27	16
Total	234	98	240	108
Gravel:				
Paving	1,374	499	835	306
Fill	94	58	98	69
Total	1,468	557	933	375
Total sand and gravel	1,702	655	1,173	483
All operations:				
Sand	4,127	4,368	4,523	4,873
Gravel	4,193	4,342	4,229	4,448
Total	8,320	8,710	8,752	9,321

[1] Includes molding, filter, grinding and polishing (1967), and other sand.
[2] Includes railroad ballast, miscellaneous, and other gravel.

duction was approximately $9.3 million, which was an increase of about 7 percent over the value for 1967. There were 60 stationary and 11 portable plants operated by commercial producers, who processed 80 percent of their 7.6 million tons of production and two stationary and six portable plants operated by Government-and-contractor producers, who processed 27 percent of their 1.2 million tons of production. Of the 7.6 million tons of commerical aggregate produced, about 47 percent was consumed for building and 33 percent for paving, and approximately 15 percent was used as fill. Approximately 1 percent of the commercial aggregate produced was moved to markets by railroad; the balance was trucked. Sand and gravel was produced in all of the State's eight counties. The two leading producers were Hartford and New Haven Counties with a combined contribution of 58 percent of the total production.

Stone.—Production and value of stone increased about 25 percent compared with that of 1967. Crushed basalt used as concrete aggregate and railroad ballast constituted about 90 percent of total production and 79 percent of total value. The unit value for crushed basalt was $1.76 per ton, an increase of 6 cents per ton compared with the price in 1967.

The output of crushed basalt came from 11 operations in Hartford, Litchfield, and New Haven Counties.

Crushed limestone was produced in Litchfield County only, by four operators. Total output increased; uses included metallurgical flux, soil neutralizer, lime manufacture, whiting, and filler.

Crushed sandstone production in Middlesex and New London Counties was used in manufacturing fine aggregate and terrazzo. Quartz and quartzite was also produced for use in glass, asphalt filler, and abrasives. Dimension sandstone was produced in Windham County, and sold primarily for use as rubble and in rough construction work. The dressed stone was sold as house stone veneer.

MINERAL FUELS

Coke.—Connecticut Coke Co. of New Haven ceased operations in 1968.

Peat.—The Cedar Swamp Peat Co. stopped production and abandoned its workings in Middlesex County in 1968.

METALS

Charles Pfizer & Co., Inc., at Canaan, Litchfield County, introduced processes for the production of iron copper powder, tradenamed Prefiltron, for use in the manufacture of electrodes, and tungsten copper for use in structural metal parts. Also at the Canaan works, Pfizer remained the only known producer of calcium metal in the United States. It is used to remove impurities during steel making. High-purity barium metal was produced for sale to the electronics, metals, and chemical industries.

Detroit Steel Co. at New Haven, imports raw material for the manufacture of cold rolled low- and high-carbon strip steel.

Carpenter Steel of New England, Inc., operated two electric furnaces and steel making facilities for the production of bars, rods, and billets.

There are more than 20 foundries in the State producing engine blocks, metal castings and housings.

Scrap metal collections, processing, and distribution were conducted by some 25 companies. Ninety percent of the finished scrap metal was exported to Europe and 10 percent was purchased by area foundries.

Nutmeg Mining Co., Falls Village, continued underground exploration in search of copper and silver near Bantam, in Litchfield County. Five hundred feet of diamond drilling has been completed, but no production was reported.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
The Michael Kane Brick Co	654 Newfield St. Middletown, Conn. 06475	Pit	Middlesex.
The Keller Pottery Co	North Wales, Pa. 19454	Pit	Hartford.
The Kelsey Ferguson Brick Co.	East Windsor Hill, Conn. 06028	Pit	Do.
Plasticrete Corp., Stiles Brick Division.	P.O. Box 248 North Haven, Conn. 06473	Pit	New Haven.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Feldspar: The Feldspar Corp.[1]	Spruce Pine, N.C. 28777	Pit	Middlesex.
Lime: Minerals, Pigments & Metals Division. Chas. Pfizer & Co., Inc.	Daisy Hill Road Canaan, Conn. 06018	Plant	Litchfield.
Gypsum (calcined): National Gypsum Company.	325 Delaware Ave. Buffalo, N.Y. 14202	do	New Haven.
Sand and gravel:			
The Balk Co	190 Huyshope Ave. Hartford, Conn. 06106	Pit	Do.
C.W. Blakeslee & Sons, Inc	58 Waverly St. New Haven, Conn. 06511	Pit	Middlesex.
The D.J. Carten Sand & Gravel Co.	Naugatuck Ave. S. P.O. Box 155 Devon, Conn. 06460	Pit	New Haven.
Connecticut Sand & Stone Corp.	7 West Main St. Plainsville, Conn. 06062	Pit	Hartford.
Danbury Sand & Gravel Co., Inc.	Mill Plain Dist. Danbury, Conn. 06810	Pit	Fairfield.
Dunning Sand & Gravel Co., Inc.	Brickyard Rd. Farmington, Conn. 06032	Pit	Hartford.
Hamden Sand & Gravel Co	375 Mather St. Hamden, Conn. 06514	Pit	New Haven.
Helming Brothers	67 West St. Bristol, Conn. 06010	Pit	Hartford.
John Lomazzo & Sons Corp	Route 57, Weston Rd. Weston, Conn. 06880	Pit	Fairfield.
Meriden Wallingford Sand & Stone.	No. Colony Rd. Wallingford, Conn. 06492	Pit	New Haven.
The New Haven Trap Rock Co.	265 Church St. New Haven, Conn. 06510	Pit	Windham.
Newington Construction Co	187 Richard St. Newington, Conn. 06111	Pit	Hartford.
Roncari Industries, Inc	1776 South Main St. East Granby, Conn. 06026	Pit	Do.
Sega Sand & Gravel, Inc	271 Danbury Rd. New Milford, Conn 06776	Pit	Litchfield.
Waterbury Sand & Gravel Co	551 South Leonard St. Waterbury, Conn. 06708	Pit	New Haven.
Stone:			
Basalt, crushed:			
The Balf Co	190 Huyshope Ave. Hartford, Conn. 06106	Quarry	Hartford.
Chas. W. Blakeslee & Sons. Inc.	58 Waverly St. New Haven, Conn. 06511	do	New Haven.
A.N. Farnham, Inc	90 Pine Rock Ave. New Haven, Conn. 06514	do	Do.
The New Haven Trap Rock Co.	265 Church St. New Haven, Conn. 06510	do	Do.
Roncari Industries, Inc	1776 South St. E. Granby, Conn. 06026	Quarry	Hartford.
Angelo Tomasso, Inc	P.O. Box 76 New Britain, Conn. 06150	do	Do.
Tomasso of Farmington, Inc.	P.O. Box 76 New Britain, Conn. 06150	do	Do.
The York Hill Trap Rock Quarry Co.	Westfield Rd. Meriden, Conn. 06450	do	New Haven.
Granite, dimension:			
Castellucci & Sons, Inc	West River St. Providence, R.I. 02904	do	Do.
R.B. Merriott & Sons	Oneco, Conn. 06373	do	Windham.
Tower Hill Granite Co	305 Manchester Rd. E. Glastonbury, Conn. 06025	do	Hartford.
Grante, crushed:The New Haven Trap Rock Co.	265 Church St. New Haven, Conn. 06510	do	Windham.
Limestone, crushed:			
Allyndale Corp	East Canaan, Conn. 06024	do	Litchfield.
The Conklin Limestone Co., Inc.	Canaan, Conn. 06018	do	Do.
Minerals, Pigments & Metals Division, Chas. Pfizer & Co., Inc.	Daisy Hill Road Canaan, Conn. 06018	do	Do.
Dolomite, crushed: United States Gypsum Co. (Falls Village).	101 So. Wacker Dr. Chicago, Ill. 60606	do	Do.
Quartzite, crushed:			
Helene Stone Corp	Danielson, Conn. 06239	do	Windham.
Ottawa Silica Co., Connecticut Silica Division.	P.O. Box 226 Mystic, Conn. 06355	do	New London.
Hughes Stone Co	R.D. Box 150 Dayville, Conn. 06241	Quarry	Windham.
Robert V. Olson	P.O. Box 684 Danielson, Conn. 06239	do	Do.

Also quartz and scrap mica.

The Mineral Industry of Delaware

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Delaware Geological Survey for collecting information on all minerals except fuels.

By Samuel A. Gustavson [1]

Mineral production in Delaware was valued at $2.0 million in 1968, down from the $2.4 million in 1967. Minerals produced in the State included common or miscellaneous clay, sand and gravel, and stone. Production of clay and stone was not significantly different from that during 1967. Sand and gravel producers, in aggregate, reported a decrease in output of about 19 percent in tonnage and 20 percent in value.

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[1] Physical science administrator, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Delaware [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays .... thousand short tons	11	$11	12	$12
Gem stones	NA	1	NA	1
Sand and gravel .... thousand short tons	1,966	1,846	1,596	1,483
Stone .... do	210	525	200	500
Total	XX	2,383	XX	1,996
Total 1957–59 constant dollars	XX	2,300	XX	p 1,913

p Preliminary. NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Indicators of Delaware business activity

	1967	1968 p	Change (percent)
Employment and labor force, annual average: [1]			
Employment .... thousands	224.2	230.3	+2.8
Manufacturing .... do	71.5	72.7	+1.7
Durable goods .... do	17.8	18.6	+4.5
Nondurable goods .... do	53.7	54.1	+.7
Nonmanufacturing .... do	125.8	131.3	+4.4
Personal income: [2]			
Total .... millions	$1,905	$2,076	+9.0
Per capita	3,635	3,888	+7.0
Construction activity:			
Cement shipments to Delaware .... thousand 376-pound barrels	1,126	1,011	−10.2
Mineral production .... thousands	$2,383	$1,996	−16.2

p Preliminary.
[1] Bureau of Employment Security, U.S. Department of Labor.
[2] Bureau of the Census, U.S. Department of Commerce.

Table 3.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1967:								
Nonmetal	13	250	3	26	-----	1	38.46	154
Sand and gravel	77	220	17	134	-----	1	7.45	171
Stone	10	218	2	20	-----	----	-------	------
Total	100	223	22	180	-----	2	11.12	150
1968: p								
Nonmetal	10	243	3	23	-----	1	42.93	730
Sand and gravel	65	212	14	112	-----	1	8.91	71
Stone	10	218	2	20	-----	----	-------	------
Total	90	217	19	155	-----	2	12.89	161

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—Delaware Brick Co. was again the only producer of clay in the State. Total annual output was virtually unchanged. Output from this operation, in New Castle County, just south of New Castle, was used to manufacture common red brick. During 1968 about 100,000 brick were given white facing on two sides.

A contract to sample and evaluate clays, slates, and related ceramic materials between the Bureau of Mines and the State of Delaware continued in force. During 1968 a total of 18 samples of clay were tested. Results of these tests, as well as those for previous years, have not been published but are available for review at the State Geologist's Office in Newark, Del.

Sand and Gravel.—Production was reported by 13 companies, three fewer than in the previous year. Sand and/or gravel pits were operated in all three counties. In addition, sand and gravel, chiefly the latter, was brought in from adjacent States. Reported production of sand was 641,000 tons valued at $688,000, a considerable increase over the 1967 production of 568,000 tons valued at $606,000. Gravel production totaled 955,000 tons valued at $795,000, a decline from the 1,398,000 tons valued at $1,240,000 reported in 1967. The decline in gravel output exceeded the increase in sand production and effected an overall decline in mineral production for the State. Of the total production 831,000 tons was processed, and the remainder was sold as bank run. Use of material was as follows, in thousand short tons: Building, 296 sand and 147 gravel; paving (or highway), 316 sand and 704 gravel; and other, including fill (engine sand) 29 sand and 104 gravel. Nearly all material was hauled by truck to destination. Prices for washed sand varied from a low of $0.75 to $1.51 per ton, gravel from $1.41 per ton to $3, and pit run material, chiefly gravel, from $0.33 to $0.60 per ton.

Stone.—Output and value of stone (gabbro) was estimated the same as in 1967. The gabbro, (classified as granite for statistical purposes) was quarried near Wilmington, New Castle County. Most of the production was crushed and sized as a concrete aggregate or as stone sand; a small quantity was sold for riprap.

In addition to the stone produced in the State, a sizable tonnage of crushed stone, used chiefly for highway construction, was purchased from sources in Pennsylvania and Maryland.

Table 4.—Principal producers

Commodity and company	Address	Type of activity	County
Clay: Delaware Brick Co	1220 Centerville Rd., Wilmington, Del. 19808	Pit	New Castle.
Sand and gravel:			
Atkins Brothers	Route 113, Millsboro, Del. 19966	Pit	Sussex.
Clough & Caulk Sand & Gravel	P.O. Box 129, Route 1, Wyoming, Del. 19934	Pit	Kent.
Delaware Sand & Gravel Co	R.D. No. 2, New Castle, Del. 19711	Pit	New Castle.
Parkway Gravel, Inc	4048 New Castle Ave., New Castle, Del. 19711	Pit	Do.
Petrillo Brothers, Inc	5 Edgemoor Rd., Wilmington, Del. 19809	Pit	Do.
St. Jones River Gravel Co	Box 426, Dover, Del. 19901	Pit	Kent.
Whittington's Sand & Gravel Co.	U.S. Route 40, Bear, Del. 19701	Pit	New Castle.
Woodlawn Gravel Co	P.O. Box 2501, Wilmington, Del. 19805	Pit	Do.

The Mineral Industry of Florida

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Florida for collecting information on all minerals except fuels.

By John W. Sweeney[1] and Earl L. Maxwell[2]

Mineral production in Florida totaled $304.6 million in 1968, $5.2 million less than that in the record year of 1967, reversing the upward trend in value of production that began in 1962. In 1968, significant value increases in most of the mineral commodities were noted, especially those related to the building industry, which in 1968 reached a record level. The overall decline in value of mineral production is directly attributable to an 8-percent decrease in the value of phosphate rock, the State's most valuable mineral commodity.

For the 75th consecutive year, Florida led the Nation in phosphate rock output, total marketable production increased 3 percent over that of 1967, setting a record high. Florida also ranked first in the production of fuller's earth and zircon, second in ilmenite, and was the only producer of staurolite.

Florida continued to be the major supplier of phosphate rock for domestic markets and a leading exporter for international markets. In 1968, Florida exports accounted for 91 percent of the total U.S. phosphate rock exports. Exports of phosphate rock from Florida ports increased 20 percent in tonnage and 9 percent in value over those of 1967. In 1968, foreign markets were more aggressively sought in an attempt to offset slow domestic sales. Florida phosphate exports moved through

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[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.

[2] Minerals statistical analyst, Division of Geology, Florida Board of Conservation, Tallahassee, Fla.

Table 1.—Mineral production in Florida[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays .... thousand short tons..	756	$11,574	808	$11,699
Lime .... do....	155	2,425	125	2,059
Natural gas .... million cubic feet..	123	18	108	16
Peat .... short tons..	22,180	155	41,213	277
Petroleum (crude) .... thousand 42-gallon barrels..	1,568	W	1,474	W
Sand and gravel .... thousand short tons..	6,912	6,479	7,765	7,967
Stone[2] .... do....	33,971	38,723	36,692	46,563
Value of items that cannot be disclosed: Cement, kyanite (1968), magnesium compounds, natural gas liquids, phosphate rock, rare-earth metal concentrates, staurolite, stone (dimension limestone), titanium concentrates, zirconium concentrates, and values indicated by symbol W	XX	250,423	XX	236,042
Total	XX	309,797	XX	304,623
Total 1957–59 constant dollars	XX	[r] 286,904	XX	[p] 278,411

[p] Preliminary. [r] Revised. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales or marketable production (including consumption by producers).

[2] Excludes dimension limestone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Florida, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Alachua	$2,187	$1,376	Limestone.
Baker	9	---------	
Bay	W	W	Sand and gravel.
Brevard	W	W	Limestone, sand and gravel.
Broward	4,865	6,450	Do.
Citrus	W	1,889	Limestone, miscellaneous clay, phosphate rock.
Clay	W	W	Ilmenite, zircon, sand and gravel, staurolite, miscellaneous clay, peat, kyanite.
Collier	W	2,693	Petroleum, limestone, natural gas.
Columbia	W	W	Limestone.
Dade	W	28,088	Cement, limestone, sand and gravel.
Duval	W	W	Oystershell, monazite, zircon.
Escambia	W	W	Sand and gravel, miscellaneous clay.
Franklin	---------	W	Sand and gravel.
Gadsden	W	W	Fuller's earth, sand and gravel, miscellaneous clay.
Gilchrist	W	W	Phosphate rock.
Glades	W	W	Sand and gravel.
Gulf	W	W	Magnesium compounds, lime.
Hamilton	W	W	Phosphate rock.
Hendry	W	W	Petroleum, sand and gravel.
Hernando	W	W	Limestone, lime.
Hillsborough	24,345	25,127	Cement, phosphate rock, oystershell, sand and gravel, peat.
Indian River	7	---------	
Jackson	93	157	Limestone, sand and gravel.
Lake	1,083	W	Sand and gravel.
Lee	W	W	Limestone, oystershell.
Leon	---------	W	Sand and gravel.
Levy	1,024	1,149	Limestone.
Manatee	W	W	Do.
Marion	W	2,734	Limestone, fuller's earth, sand and gravel, phosphate rock.
Martin	---------	W	Peat.
Monroe	W	W	Limestone.
Orange	184	51	Peat.
Palm Beach	631	661	Limestone, sand and gravel.
Pinellas	518	685	Oystershell, sand and gravel.
Polk	183,765	165,743	Phosphate rock, sand and gravel, peat.
Putnam	W	1,238	Kaolin, sand and gravel, peat.
St. Lucie	W	W	Sand and gravel.
Sarasota	W	---------	
Sumter	W	2,366	Limestone, lime, peat.
Suwannee	W	W	Limestone.
Taylor	71	W	Limestone.
Volusia	W	W	Sand and gravel.
Walton	W	W	Oystershell, sand and gravel.
Washington	6	W	Sand and gravel.
Undistributed [2]	91,009	64,216	
Total	309,797	304,623	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Bradford, Calhoun, Charlotte, DeSoto, Dixie, Flagler, Hardee, Highlands, Holmes, Jefferson, Lafayette, Liberty, Madison, Nassau, Okaloosa, Okeechobee, Osceola, Pasco, St. Johns, Santa Rosa, Seminole, Union, and Wakulla.

[2] Includes value of natural gas liquids and counties indicated by symbol W.

the ports of Tampa, Boca Grande, and Jacksonville; shipments were made to 34 foreign countries, with Japan, West Germany, Canada, and Italy each receiving more than 1 million short tons of phosphate rock. For the second year in a row domestic shipments were not as large as anticipated, caused by a short fertilizing season in the Midwest.

Electrical energy requirements continued to increase in the State, and sales increased over 11 percent. The only decrease noted in industrial consumption was that by the phosphate industry and was the result of the industry adjustments for overproduction in 1968. Construction at Florida Power Corp.'s Crystal River plant continued on generating unit No. 2 which will have a capacity of 512,000 kilowatts and will be coal-fired; construction of this unit is scheduled for completion in late 1969. The U.S. Atomic Energy Commission licensed Florida Power Corp. to construct a nuclear-fuel generating unit at its Crystal River plant; the unit is scheduled to begin operation in 1972. Construction began at Tampa Electric Co.'s Big Bend Power Station near Tampa; the first 450,000-kilowatt unit is scheduled for completion in 1970.

Table 3.—Indicators of Florida business activity

	1967	1968	Change (percent)
Employment and labor force, annual average:			
Total nonagricultural employment............thousands..	[r] 1,824	1,935	+6.1
Manufacturing.............................do....	[r] 292.8	308.2	+5.3
Mining....................................do....	9.2	8.6	−6.5
Nonmetallic minerals, except fuels........do....	8.4	7.7	−8.3
Phosphate rock............................do....	6.2	5.6	−9.7
Personal income:			
Total..................................millions..	[r] $17,101	$18,950	+10.8
Per capita..	[r] $2,834	$3,081	+8.7
Construction activity:			
Housing units authorized............................	[r] 65,775	107,042	+62.7
Value of construction..................thousands..	$784,225	1,367,314	+74.4
New business incorporations.........................	12,390	14,813	+19.6
Farm marketing receipts................millions..	$1,062.2	$1,218.3	+14.7
Mineral production........................do....	$309.8	$304.6	−1.7
Utility sales or consumption: Sales of electrical energy million kilowatt hours..	34,608	38,638	+11.6
Export trade...........................millions..	$749.6	$866.3	+15.6
Import trade..............................do....	$591.7	$766.5	+29.5

[r] Revised.

Sources: Florida Industrial Commission; Survey of Current Business, U.S. Department of Commerce.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Peat...............	19	255	5	42	-------	1	23.55	1,130
Metal..............	147	350	51	411	-------	-------	-------	-------
Nonmetal...........	3,785	299	1,130	9,051	3	73	8.40	3,385
Sand and gravel....	337	256	86	765	-------	24	31.38	616
Stone..............	2,201	289	636	5,637	2	105	18.98	2,735
Total [1]...........	6,489	294	1,909	15,907	5	203	13.08	2,928
1968:[p]								
Peat...............	32	248	8	58	-------	-------	-------	-------
Metal..............	140	353	50	399	-------	-------	-------	-------
Nonmetal...........	3,540	303	1,074	8,602	-------	85	9.88	273
Sand and gravel....	315	254	80	690	1	18	27.52	9,521
Stone..............	2,300	297	685	6,125	2	95	15.84	2,821
Total [1]...........	6,325	300	1,896	15,874	3	198	12.66	1,650

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

The Ohio River Co.'s phosphate terminal at East Bay was completed in November. The total system provides for the movement of wet phosphate rock by unit train from the phosphate mines to East Bay, rail-water transfer, and large-volume barge movement across the Gulf of Mexico to Freeport Sulphur Co.'s chemical complex at Convent, La. Construction of an $8.5 million rail-ship terminal for loading ocean-going vessels was begun by the Seaboard Coastline Railroad at East Bay. The facility will provide for 130,000 tons of dry storage and have a loading rate of 3,000 tons per hour. The total annual throughput capacity will be in excess of 10 million tons. Completion of this facility is scheduled for late 1969. Seaboard announced that after completion of the East Bay facility the company plans to phase out its phosphate elevators at Port Tampa and Port Boca Grande.

Construction of Port Manatee began; facilities will include two phosphate elevators each rated with a loading capacity of 3,000 tons per hour. Levy County Port

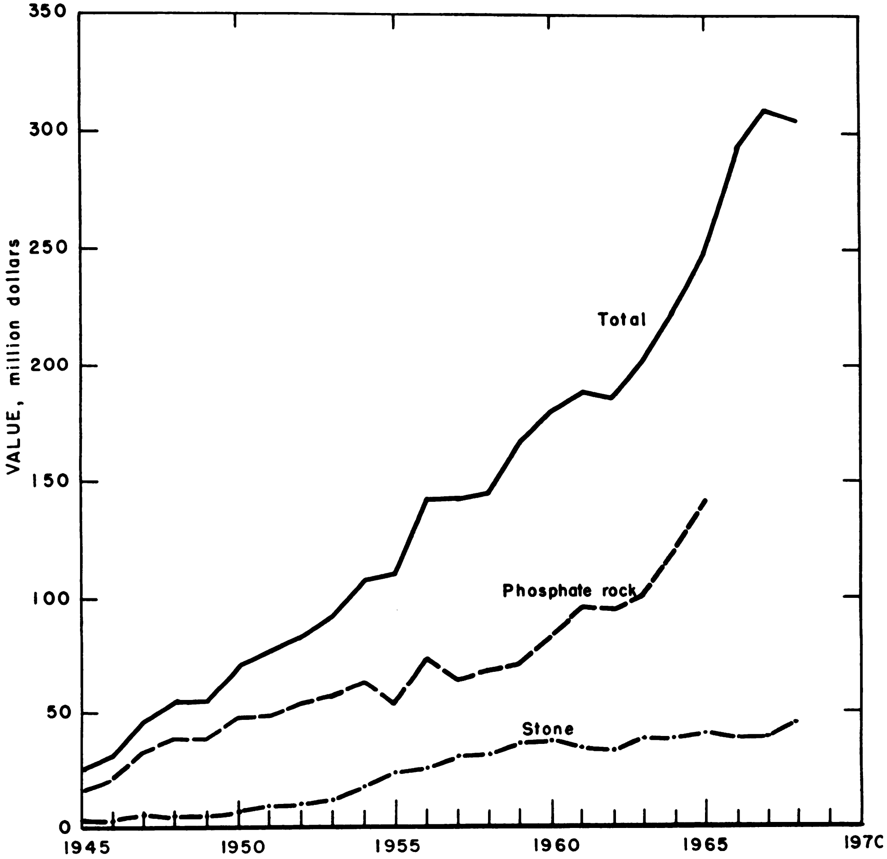

Figure 1. Value of phosphate rock, stone, and total value of mineral production in Florida.

Authority signed preliminary contracts which may lead to the development of the first port facilities at Port Inglis near the western terminus of the Cross-Florida Barge Canal. The Port Inglis Authority contemplates shipments of grain by barge into Florida from Midwestern points and phosphate products shipped out on the return trip of the barges to the upper gulf coast. It is expected that Occidental Chemical Co. will be the primary supplier of phosphate out of this port.

Mobil Oil Corp. drilled an exploratory well in the Gulf of Mexico about 6 miles southwest of Apalachicola, Franklin County. The well was a dry hole and was terminated at 14,366 feet.

Florida Steel Corp. announced plans to construct an 80,000-ton annual capacity electric furnace and rolling mill in Dade County.

The Florida economy advanced in most sectors of business and agricultural activities as shown in table 3. As an indicator of a healthy economy, nonagricultural employment increased 6.1 percent and manufacturing employment increased 5.3 percent over 1967 figures. The only decrease noted was in mining employment; this drop was directly related to reduced domestic phosphate sales which resulted in several phosphate mine and plant closures and cutbacks at other operations. Housing construction had the largest expansion with

62.7 percent more units built in 1968. Value of construction was 74.4 percent higher. The construction activity was more prevalent in the metropolitan areas of the State. Much of the construction was multiple dwelling units. Exports increased 15.6 percent, part of this can be attributed to an increase in phosphate exports.

Legislation and Government Programs.—The Bureau of Mines Tuscaloosa Metallurgy Research Laboratory, Tuscaloosa, Ala., conducted research on Florida land-pebble phosphate. The objectives were to develop alternate methods for beneficiating Florida land-pebble phosphate matrix with emphasis on devising processes which will increase recovery of fine phosphate values and obtain higher recovery of the coarser phosphate values.

The Tennessee Valley Authority (TVA) contracted for purchases of phosphate rock from Agrico Chemical Co. and Mobil Chemical Co. TVA stated that these two contracts were the first to include a provision requiring land reclamation equal to the land disturbed in mining of the phosphate rock.

Over 115 miles or 62 percent of the Cross-Florida Barge Canal has been completed, including three locks and two dams. A mid-1973 completion date has been set by the Canal Authority. Congress passed a bill authorizing construction of 190 miles of Gulf Intracoastal Waterway between Tampa Bay and St. Marks.

A bill was introduced in the State Legislature which proposes a 5-percent severence tax on minerals. Legislative hearings on a proposal to conduct limestone mining in Lake Okeechobee, were held. On the county level, the Manatee County Planning Board approved amendments to the county mining ordinances requiring an annual audit of a mining company to prove the company is financially responsible for its mining operations and land reclamation. The establishment of a water regulatory district controlling subsurface water resources in Polk County has been proposed to safeguard future water supplies.

The Division of Geology, Florida Board of Conservation continued studies of mineral resources throughout the State. The results of several water resource studies were published during the year.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for 95 percent of the State's total mineral production value, compared with 94 percent in 1967. Principal nonmetals produced, listed in order of value, were phosphate rock, stone, cement, clays, and sand and gravel.

Cement.—The quantity and value of portland and masonry cement shipments both increased 14 percent and 16 percent, respectively. Increased shipments are directly related to the increased construction activity in most of the State's metropolitan areas.

Types I and II (general-use and moderate-heat), and Type III (high-early strength) cements were produced. Most of the shipments were made within the State, but shipments were also made to Georgia, North Carolina, and other States. Masonry cement shipments were principally within the State, but small amounts were shipped to Georgia. Shipments, chiefly in bulk form, were made by truck (78 percent) and by rail (22 percent). Principal consumers were ready-mixed concrete companies, concrete products manufacturers, and building materials dealers.

Raw materials used in the manufacture of cement were mined principally within the State, and included limestone, clay, and sand. Ten rotary kilns were operated at the three plants which had a total capacity of over 12 million barrels per year. All used the wet process. Over 237 million kilowatt-hours of electrical energy were consumed in the manufacture of cement; 90 percent of the power was purchased and the remainder was home generated.

General Portland Cement Co. announced plans for expanding the capacity of its Miami plant by 50 percent.

Clays.—Total clay output increased 7 percent, and value increased 1 percent. Increases in output and value were noted for all types of clay produced.

Florida for the 11th consecutive year led the Nation in fuller's earth production. Fuller's earth output increased 1 percent in tonnage and showed a slight increase in value. Three producers were active in Gadsden County and one producer in Marion County. The material was used for absorbents (40 percent), insecticides and fungicides (32 percent), drilling mud (15 percent), mineral oils (7 percent), paper, soil, and vegetable uses (about 6 percent); a small amount was exported.

Kaolin output increased 12 percent and the value increased 9 percent over that of 1967. Kaolin was produced by two companies in Putnam County; principal uses were in whiteware, pottery, and wall tile. During the year, Edgar Plastic Kaolin Co. was acquired by National Lead Co. The acquisition included kaolin mining and processing facilities at Edgar and a glass sand mine and plant near Plant City.

Miscellaneous clay increased 13 percent in tonnage and 18 percent in value due to increased consumption in the manufacture of lightweight aggregate and cement.

Gypsum.—Three companies calcined imported crude gypsum for manufacture of gypsum building products. Two firms operated plants near Jacksonville, Duval County; and the third operated a plant near Tampa, Hillsborough County. The three plants used nine calcining kettles, one rotary kiln, one holoflite, and four board machines in the processing and manufacture of gypsum and gypsum products; total capacity of the plants was in excess of 500,000 tons of calcined product. Crude ore for all operations was transported by ship from company owned deposits in Nova Scotia.

Kyanite.—A small amount of kyanite-sillimanite mixture was recovered from tailings of a heavy minerals operation. The material was marketed for refractory uses.

Lime.—Primary lime sold or used totaled 125,000 tons valued at $2.0 million representing decreases of 19 and 15 percent, respectively, from 1967 levels. One company manufactured quicklime for use in recovery of magnesia from sea water. Two other companies produced primary lime in the form of quicklime and hydrated lime for various chemical uses. The major marketing area was in the State with a small amount sold in Georgia. Six companies and the City of Miami, in seven counties, recovered 671,000 tons of regenerated lime valued at $12 million for use principally in manufacturing paper, in alkalies, and for water treatment.

Magnesia.—Basic Magnesia, Inc., of Cleveland, Ohio, acquired Michigan Chemical Corp.'s magnesia plant at Port St. Joe, Fla. The plant has an annual capacity of 60,000 tons of refractory periclase and chemical magnesia derived from sea water. Principal uses of the magnesium compounds were for refractories, building materials, sugar refining.

Perlite.—Three companies expanded perlite in three counties from ore mined in Colorado and New Mexico; total output was more than 8,500 tons valued at $598,000, representing increases of 9 and 11 percent, respectively, in tonnage and value over 1967 levels. The expanded perlite was used for building plaster, concrete aggregate, soil conditioning and insulation.

Phosphate Rock.—Marketable production of phosphate rock again reached a new high, and accounted for the major portion of the State's total mineral production value. For the 75th consecutive year, Florida led the Nation in output and value of this commodity.

Florida's 1968 production is combined with that of North Carolina to conceal the latter's output, because there is only one producing company in North Carolina. Combined marketable production from both States in 1968 was 33 million short tons valued at $193.3 million and represented 81 percent of the total national output. This was a 4-percent increase over the 31.9-million-ton output, but a decrease in value of 7 percent from the $207.7 million produced in 1967. The value decline is directly related to an oversupply situation which resulted in low prices in 1968. Marketable production sold or used totaled 29.6 million tons valued at $173 million, a 1-percent decrease from the 29.8 million tons sold or used and a 10-percent decrease in value from that of 1967. Producers' stocks increased 47 percent at yearend, amplifying the oversupply and slow sales situation that the industry experienced in 1968. Of that sold or used, agricultural uses accounted for 18 million tons, or 61 percent; industrial uses 365,000 tons, or 1 percent; and exports 11.2 million tons, or 38 percent. Exports from the two States were valued at $68.3 million. Agricultural uses were for ordinary superphosphate, triple superphosphate, wet process phosphoric acid, nitrophosphate, direct application to the soil, stock and poultry

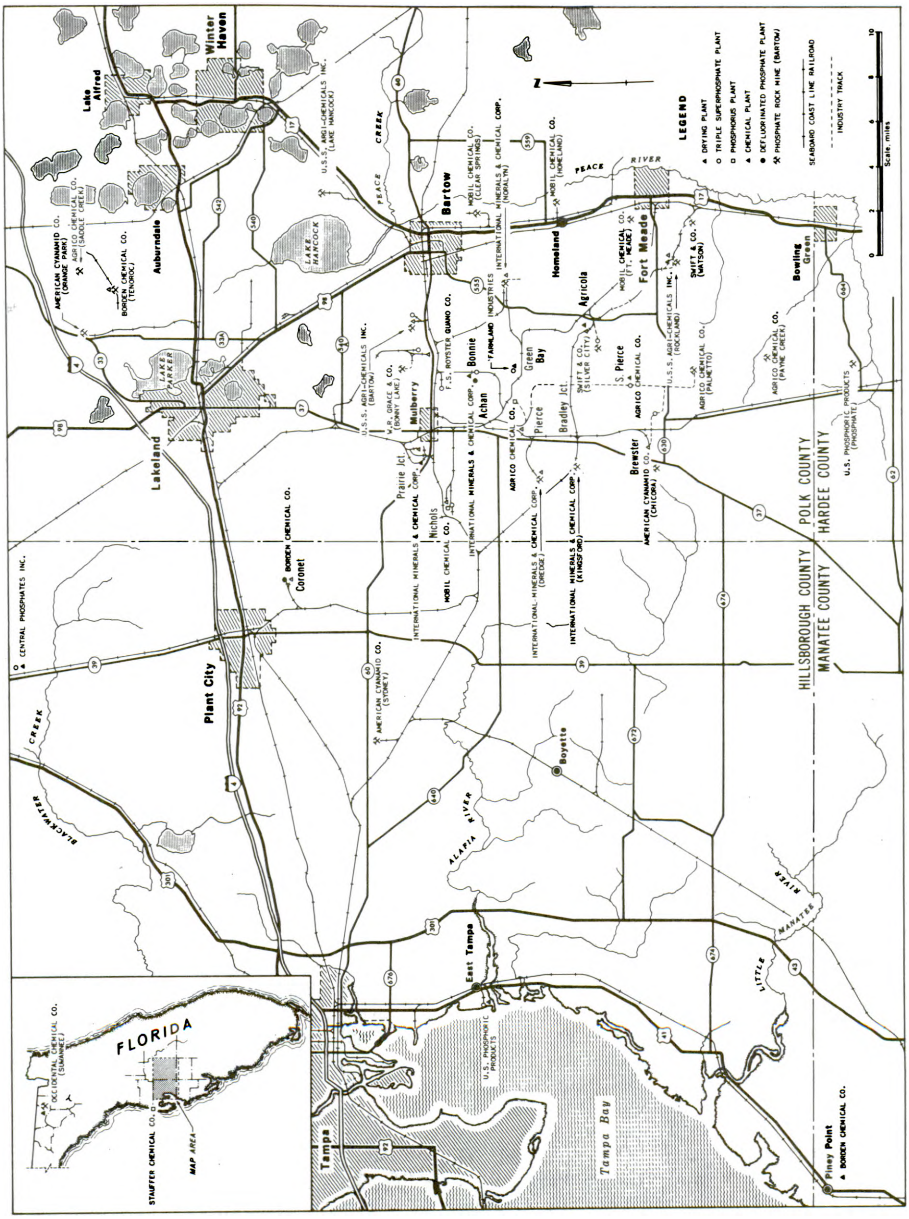
LEGEND
▲ DRYING PLANT
○ TRIPLE SUPERPHOSPHATE PLANT
□ PHOSPHORUS PLANT
▲ CHEMICAL PLANT
● DEFLUORINATED PHOSPHATE PLANT
⚒ PHOSPHATE ROCK MINE (BARTOW)
SEABOARD COAST LINE RAILROAD
INDUSTRY TRACK
Scale, miles
0 2 4 6 8 10
N
Lake Alfred
Winter Haven
Auburndale
Lakeland
Plant City
Bartow
Homeland
Fort Meade
Bowling Green
Mulberry
Bonnie
Achan
Green Bay
Pierce
Bradley Jct.
S. Pierce
Agricola
Brewster
Prairie Jct.
Nichols
Coronet
Boyette
East Tampa
Tampa
Tampa Bay
Piney Point
LAKE HANCOCK
LAKE PARKER
PEACE CREEK
PEACE RIVER
ALAFIA RIVER
LITTLE MANATEE RIVER
BLACKWATER CREEK
POLK COUNTY
HARDEE COUNTY
HILLSBOROUGH COUNTY
MANATEE COUNTY
AMERICAN CYANAMID CO. (ORANGE PARK)
AGRICO CHEMICAL CO. (SADDLE CREEK)
BORDEN CHEMICAL CO. (TENOROC)
U.S.S. AGRI-CHEMICALS INC. (LAKE HANCOCK)
MOBIL CHEMICAL CO. (CLEAR SPRINGS)
INTERNATIONAL MINERALS & CHEMICAL CORP. (NORALYN)
MOBIL CHEMICAL CO. (HOMELAND)
MOBIL CHEMICAL CO. (FT. MEADE)
SWIFT & CO. (WATSON)
U.S.S. AGRI-CHEMICALS INC. (ROCKLAND)
AGRICO CHEMICAL CO. (PALMETTO)
AGRICO CHEMICAL CO. (PAYNE CREEK)
U.S. PHOSPHORIC PRODUCTS (PHOSPHATE)
SWIFT & CO. (SILVER CITY)
AGRICO CHEMICAL CO.
AMERICAN CYANAMID CO. (CHICORA)
INTERNATIONAL MINERALS & CHEMICAL CORP. (KINGSFORD)
INTERNATIONAL MINERALS & CHEMICAL CORP. (DREDGE)
FARMLAND INDUSTRIES
F.S. ROYSTER GUANO CO.
INTERNATIONAL MINERALS & CHEMICAL CORP.
MOBIL CHEMICAL CO.
U.S.S. AGRI-CHEMICALS INC. (BARTOW)
W.R. GRACE & CO. (BONNY LAKE)
BORDEN CHEMICAL CO.
CENTRAL PHOSPHATES INC.
AMERICAN CYANAMID CO. (SYDNEY)
U.S. PHOSPHORIC PRODUCTS
BORDEN CHEMICAL CO.
FLORIDA
OCCIDENTAL CHEMICAL CO. (SUWANNEE)
STAUFFER CHEMICAL CO.
MAP AREA

Figure 2.—Location of phosphate mines and plants in the Florida land-pebble areas, 1968.

feed, and fertilizer filler. Industrial uses included the manufacture of elemental phosphorus.

Mine production of crude dry ore in Florida and North Carolina was 135.9 million short tons with a P_2O_5 content of 26.1 million tons.

Land-pebble phosphate rock was produced at 20 mines by 10 companies in three counties. One other company processed tailings from an abandoned mine.

Hard-rock phosphate was not produced in the State during the year.

Soft-rock phosphate was produced by five companies at six mines in three counties. Total mine production was 30,000 tons with P_2O_5 content of 6,000 tons, valued at $224,000. The production trend of Florida soft-rock phosphate continued to decline, because of depletion of the soft-rock phosphate deposits. The material was used for direct application to the soil, in stock and poultry feed, and as fertilizer filler.

Phillips Petroleum Corp. was granted a 20-year mining permit by Manatee County to mine phosphate on 6,500 acres of land owned by the company in the southeastern part of the county. No date for development of the mining operations has been set. The company reportedly began construction of a $70 million processing installation in Brazil to which phosphate rock mined in Manatee County will be shipped.

PPG Industries acquired leases on sizable phosphate rock reserves in the central Florida land-pebble district.

Several reports describing Florida phosphate process computer control, environmental quality control, and phosphate terminal facilities were published.[3]

Agrico Chemical Co. operated its Payne Creek, Saddle Creek, and Palmetto mines and plants in Polk County. During the year the company bought the Orange Park plant of American Cyanamid Co. The company installed a shell dryer at its Pierce complex; the 10-foot-diameter by 80-foot-long unit handles about 350 tons per hour of phosphate rock, reducing the moisture content from 12 to 1 percent.

American Cyanamid Co. operated its Chicora, Sydney, and Orange Park mines and plants. Late in the year the Orange Park plant was sold, as mentioned above. The company announced its completion of a system of water retention which will reduce the loss of ground water by 50 percent in its mining process. The company deeded a 55-acre tract to the Southwest Florida Water Management District, beginning the final phase of a major conservation-recreation project that was started in 1963. This is the first of a series of land donations by the company to the State, which will culminate in a total of 1,160 acres by 1970. The Southwest Florida Water Management Districts plans to construct a dam which will form the Pleasant Grove Reservoir. The 740-acre lake will be surrounded by more than 400 acres of reclaimed land for recreational use.

Borden Chemical Co. operated its Tenoroc mine and Piney Point fertilizer manufacturing complex throughout the year.

W. R. Grace & Co., Agricultural Products Division, continued operation of its Bonny Lake mine and plant. The company has stated that it has abundant reserves of phosphate rock, and has the capacity to produce annually 970,000 tons of superphosphate and 800,000 tons of concentrated phosphate. Grace manufactures and distributes high analysis and mixed fertilizers from their Florida operations.

International Minerals & Chemical Corp. (IMC) operated three mines—the Kingsford, Noralyn, and Dredge mines—all in Polk County. During the year, IMC merged with Continental Ore Corp. The consolidation is expected to benefit IMC by adding to its range of minerals and metals and strengthen its markets in the European countries. IMC acquired all the assets of Chemicals, Inc.; the facilities consist of four sulfuric acid plants, two ammonia plants and a steam plant, all adjacent to IMC's Bonnie complex. Late in the year, IMC was negotiating for the sale of its Bonnie phosphate chemicals complex to Central Farmers Fertilizer Co. The transaction will include the phosphate fertilizer and sulfuric acid plants at Bonnie. IMC will retain its feed ingredients facility and supply phosphate rock to the Bonnie complex.

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[3] Cross, William C. Process Computer Control at IMC. Min. Cong. J., v. 54, No. 10, October 1968, pp. 22–29.

Florida Journal of Commerce. Contract for 12-Million Ton Capacity Phosphate Terminal Let by Seaboard Coastline at Tampa. July 1968, pp. 6–8.

Wells, Earl. Florida Phosphate Producers—Environmental Quality Control Report. Min. Cong. J., v. 54, No. 7, July 1968, pp. 30–34.

Minerals Recovery Corp. processed tailings from previous operations at its Sand Mountain recovery plant near Bartow.

Mobil Chemical Co. operated three mines, all in Polk County, during the year. Output was used in the manufacture of concentrated superphosphates, phosphoric acid, nitraphosphate, for direct application to the soil, and in electric furnace manufacture of elemental phosphorus. The company has equipped a $60,000 mobile pollution-control laboratory which will be used to sample the air and water near its agricultural chemical plants. The unit is equipped to determine if waste water contains fluorides or other pollutants, and if sulfur dioxide, particle matter, and excessive dust are being emitted into the air. Late in the year the company closed its Harding chemical plant at Nichols.

Occidental Chemical Co. operated its Suwannee River mine and plant in Hamilton County. At this complex, the company processes 550,000 tons per year of chemical fertilizers, which include 54 percent phosphoric acid, diammonium phosphate, triple superphosphate, and superphosphoric acid of about 76 percent P_2O_5. The company gets sulfur from its Jefferson Lake Sulphur subsidiary at Long Point Dome, Texas. The company has entered into agreements with Continental Can Co. for purchase of additional phosphate deposits in Hamilton County. Approximately 1 million tons of phosphate rock was shipped by the company through Jacksonville Bulk Terminals and transported in deep-sea vessels to foreign and domestic ports.

Swift & Co. operated the Watson and Silver City mines and plants all in Polk County, during the year. Output was used in the manufacture of ordinary superphosphate and triple superphosphate, and for direct application to the soil.

U.S. Phosphoric Products, Division Tennessee Corp., operated its Phosphate mine and beneficiation plant near Fort Meade during the year. Output was used in the manufacture of ordinary superphosphate, triple superphosphate, and phosphoric acid.

U.S.S. Agri-Chemicals, Inc., purchased the entire phosphate assets of Armour Agricultural Chemical Co. The sale was consummated July 1, 1968, and included the Bartow mine and plants and the Rockland mine and plant, the latter a joint venture with Freeport Sulphur Co. The Lake Hancock mine, which has been in operation since 1962, closed at midyear, and the 21-cubic-yard dragline was moved to the Bartow mine. This will increase production at the Bartow mine to about 1.25 million tons per year and permit a greater utilization of the capacity at the Bartow processing complex.

Table 5.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1967			1968		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Baker	1	11	$9	------	------	------
Brevard	1	24	25	1	W	W
Broward	4	321	324	3	W	W
Dade	1	W	W	4	W	$160
Escambia	5	468	437	5	371	379
Gadsden	1	241	W	2	288	W
Indian River	1	8	7	------	------	------
Lake	5	1,496	1,083	5	W	W
Marion	1	11	32	2	55	66
Orange	1	151	104	------	------	------
Palm Beach	1	84	68	1	81	50
Pinellas	1	7	5	1	11	9
Polk	8	2,065	1,983	7	2,365	2,613
Putnam	5	626	476	5	490	W
St. Lucie	2	84	W	3	245	W
Washington	1	8	6	1	W	W
Undistributed [1]	8	1,307	1,920	11	3,859	4,690
Total	47	6,912	6,479	51	7,765	7,967

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes Bay, Clay, Franklin (1968), Glades, Hendry, Hillsborough, Jackson (1968), Leon (1968), Volusia, and Walton Counties, and counties indicated by symbol W.

Table 6.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967			1968		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	4,975	$3,937	$0.79	6,267	$5,268	$0.84
Paving	773	594	.77	254	227	.89
Fill	482	299	.62	W	W	W
Blast	54	403	7.46	W	W	W
Gravel	W	W	W	W	W	W
Total sand and gravel [1]	6,912	6,479	.94	7,765	7,967	1.03

W Withheld to avoid disclosing individual company confidential data; included with "Total sand and gravel."

[1] Includes glass, molding, engine, filtration, filler, and other sands; paving and structural gravel.

Sand and Gravel.—Sand and gravel output was 7.7 million tons valued at $7.9 million in 1968; production increased 12 percent in tonnage and 23 percent in value. These increases parallel the large increases in construction activity in the State. Polk County was the leading producing county accounting for 30 percent of the output and 33 percent of the value. This county supplied much of the silica sand needs of central and southern Florida. Of the total sand tonnage, nearly all was produced by commercial operators. There were 49 commercial sand and gravel operations during the year; of these, 13 produced between 200,000 and 700,000 tons, 18 produced from 50,000 to 200,000 tons; and 18 produced less than 50,000 tons. Of the output, 72 percent was transported by truck, 27 percent by rail, and 1 percent by water. The sand and gravel was used mainly for construction purposes with a small amount going into industrial uses. The value per ton of commercial sand and gravel ranged from $0.61 to $7.81 and averaged $1.03. E. R. Jahna Industries, Inc., announced that it will open a new sand mine at Loughman, Polk County. The sand will be recovered by dredging and processed through a completely automated sand grading plant.

Staurolite.—Staurolite was recovered as a byproduct of ilmenite production at the Highland and Trail Ridge plants in Clay County. Both output and value increased slightly over 1967. Florida is the only State with a recorded production of staurolite.

Stone.—Florida stone (all limestone) is divided into two types, hard-rock and soft-rock. Each type has a different end use and value. Hard-rock used as concrete aggregate and bituminous aggregate ranges in value from $1.25 to $1.90 per ton. Soft-rock is used for dense-graded road-base material, agricultural limestone, and the manufacture of lime, and ranges in value as soft-rock from $0.70 to $0.90 per ton.

Hard-rock limestone is produced in Broward, Dade, Hernando, Lee, Monroe, and Suwannee Counties. Stone from deposits in these counties supply the needs of the rapidly growing metropolitan areas of the State. Construction activity in the State in 1968 reached record levels which kept the demand high for concrete aggregates. This caused producers to increase the price of their aggregates during the year.

Soft-rock limestone is produced in Alachua, Brevard, Broward, Citrus, Collier, Columbia, Dade, Jackson, Lee, Levy, Manatee, Marion, Monroe, Palm Beach, and Sumter Counties. Stone from deposits in these counties supplied the needs of the State for road base material, lime, and cement manufacture. Soft-rock limestone accounted for approximately 63 percent of the output and 56 percent of the value of the crushed limestone produced in 1968.

Total stone output, excluding dimension limestone was 36.7 million tons valued at $46.6 million, setting a record for stone output and value in 1968.

Crushed limestone output was 35.5 million tons valued at $44.6 million, increases of 9 percent in tonnage and 20 percent in value over 1967 levels. The value increase is attributed mainly to increased prices by producers in Broward and Hernando Counties caused by the heavy demand for building construction materials. Output came from 85 quarries in 18 counties, compared

Table 7.—Crushed limestone sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1967			1968		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Alachua	5	2,274	$2,187	6	2,047	$1,376
Broward	11	4,114	4,541	12	5,041	W
Collier	5	1,026	829	6	1,129	W
Dade	12	9,581	9,860	14	10,162	W
Hernando	8	6,201	7,552	8	6,492	9,991
Jackson	1	31	93	2	W	W
Levy	3	545	1,024	3	472	1,149
Marion	7	1,002	1,895	7	1,579	W
Monroe	------	--------	--------	2	1,313	W
Palm Beach	3	629	563	5	598	611
Sumter	3	2,760	2,619	3	1,875	W
Taylor	1	71	71	2	W	W
Undistributed [1]	15	4,384	5,436	15	4,889	31,486
Total [2]	74	32,618	36,670	85	35,548	44,612

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes Brevard (1968), Citrus (1968), Columbia (1968), Lee, Manatee (1968), and Suwannee (1968) Counties, and counties indicated by symbol W.

[2] Data may not add to total shown because of independent rounding.

Table 8.—Crushed limestone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967			1968		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Agricultural stone	777	$2,412	$3.10	929	$2,966	$3.19
Concrete aggregate	28,885	30,737	1.06	10,560	14,827	1.40
Bituminous aggregate	(1)	(1)	--------	497	880	1.77
Dense graded base stone	(1)	(1)	--------	15,877	18,090	1.14
Surface treatment aggregate	(1)	(1)	--------	1,138	928	.82
Other uses [2]	2,956	3,520	1.19	6,547	6,921	1.06
Total [3]	32,618	36,670	1.12	35,548	44,612	1.25

[1] Included in concrete aggregate 1967.

[2] Includes railroad ballast, cement, lime, fill, riprap (1967), poultry grit (1968), filter stone (1968), manufactured fine aggregate (1968), chemical stone (1968), asphalt filler (1968), and other uses.

[3] Data may not add to total shown because of independent rounding.

with 74 quarries in 18 counties in 1967. The three leading producing counties were Dade, Hernando, and Broward, which supplied 61 percent of the total State tonnage and value. Eleven companies operated 29 quarries accounting for 69 percent of the crushed limestone output and 66 percent of the value. Of the total crushed limestone sold or used, agricultural stone accounted for 3 percent of the output and 7 percent of the value; concrete aggregate, 30 percent and 33 percent; bituminous aggregate 1 percent and 2 percent; dense graded road base stone 45 percent and 41 percent; surface treatment aggregate 3 percent and 2 percent; and other uses 18 percent and 16 percent. Crushed limestone was transported 75 percent by truck, 23 percent by rail, and 2 percent by water.

A paper was published describing a crushed stone producer in Dade County.[4]

Oystershell was dredged and crushed by five companies in five counties on State leases. Total output was 1.1 million tons valued at $1.9 million, decreases of 15 percent in tonnage and 5 percent in value below 1967 levels. Most of the oystershell was used as dense graded road base material, and a smaller tonnage was used for poultry grit.

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[4] The Dixie Contractor. Florida Aggregate Producer Banks on Standardization. V. 43, No. 13, November 1968, pp. 22–23.

Only one company, in Manatee County, produced cut stone for decorative uses.

Vermiculite.—Exfoliated vermiculite was produced at four plants in Duval, Hillsborough, and Palm Beach Counties.

METALS

Metals accounted for only 3 percent of the State's total mineral production value.

Ferroalloys.—Three companies produced ferrophosphorus as a byproduct of elemental phosphorus manufacture. The value of ferroalloys is not included in the total State value.

Rare-Earth Minerals.—One company reclaimed rare-earth metal concentrates from tailings. Shipments of concentrates decreased considerably below those of 1967, as the tailings were worked out.

Titanium Concentrates.—Shipments of ilmenite concentrate increased 25 percent in tonnage and 11 percent in value over 1967 levels. This increase in Florida shipments paralleled the increase in the national demand for titanium minerals.

During the year, the Bureau of Mines conducted research on recovery of heavy mineral concentrates from Florida phosphate. A second part of this research was to develop new or improved methods to recover high-grade concentrates of rutile, ilmenite, zircon, and monazite from mixed heavy mineral concentrates.

Zirconium Concentrates.—Florida led the Nation in zircon output. Shipments of zirconium concentrate decreased 1 percent, but value increased 5 percent over that of 1967. Zirconium concentrates were recovered from ilmenite mining by two companies.

MINERAL FUELS

Mineral fuels production consisted of natural gas, crude petroleum and its derivatives, and peat. Fuels accounted for only 2 percent of the State's total mineral production value.

Natural Gas.—All natural gas production came from the Sunniland field, Collier County, and was used in company operations as fuel for pumping crude petroleum. Production reports indicate a decrease in output compared with the 1967 figure.

Peat.—Peat production and value increased considerably compared with 1967 levels. Eleven companies in seven counties produced 41,200 tons of humus, moss, and reed-sedge peat valued at $277,000; most of the material was shredded and sold in bulk for soil improvement purposes.

Petroleum.—Crude petroleum production from the State's two oilfields decreased 6 percent below that of 1967. A total of 1,474,485 barrels of oil were produced from the Sunniland field in Collier County and the Sunoco-Felda field in Collier and Hendry Counties. Cumulative production, 1943–68, from the Sunniland field was 11.1 million barrels of low-gravity oil; production in 1968 came from 18 wells. In 1968, 29 pumping wells in the Sunoco-Felda field yielded 893,030 barrels of oil with a gravity of about 24° API; the cumulative production, 1964–68, of the field was 3.5 million barrels. In 1968, one well was drilled in Humble's Sunniland field as a north offset to the field. Initial production from this well was 27 barrels of oil per day, and 320 barrels of water. In the Sunoco-Felda field, two producing wells and one dry hole were drilled. The producing wells were offset to a commercially marginal stepout.

Florida offshore geophysical activity continued through 1968, within State and Federal waters of the Gulf of Mexico. In 1968, 19 permits were issued for geophysical surveys in these waters. On the Florida mainland 72 crew-weeks of geophysical activity were performed.

The State Board of Conservation (Order No. 10) approved the unitization of the Sunoco-Felda field for the purpose of injection of fresh water to conserve reservoir energy. Three dry or marginally productive wells will be converted into injection facilities.

Table 9.—Oil and gas well drilling in 1968, by counties

County	Oil	Dry	Total[1]	Footage
Exploratory completions:				
Collier	-----	1	1	11,575
Columbia	-----	2	2	6,193
Dade	-----	1	1	11,603
Hendry	-----	1	1	11,555
Hernando	-----	1	1	6,764
Palm Beach	-----	1	1	10,905
Santa Rosa	-----	1	1	6,513
Total	-----	8	8	65,108
Development completions:				
Collier	1	-----	1	11,705
Hendry	2	1	3	34,606
Total	3	1	4	46,311
Total all drilling	3	9	12	111,419

[1] No gas wells.
Source: American Association of Petroleum Geologists.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Cement, portland and masonry:			
General Portland Cement Co	Box 1528 Tampa, Fla. 33601	2 plants	Dade and Hillsborough.
Lehigh Portland Cement Co	718 Hamilton St. Allentown, Pa. 18105	Plant	Dade.
Clays:			
Fuller's earth:			
Dresser Industries, Inc	Box 6504 Houston, Tex. 77005	Open-pit mine	Gadsden.
Engelhard Minerals & Chemicals Corp.	Menlo Park Edison, N.J. 08817	2 open-pit mines	Do.
Floridin Co	Berkeley Springs, W. Va. 25411	Open-pit mine	Do.
Mid-Florida Mining Co	Box 68-F Lowell, Fla. 32663	do	Marion.
Kaolin:			
Cyprus Mines Corp	Box 1201 Trenton, N.J. 08606	Open-pit mine and plant	Putnam.
Edgar Plastic Kaolin Co	Edgar, Fla. 32049	do	Do.
Miscellaneous:			
Appalachee Correctional Institute.	Box 127 Chattahoochee, Fla. 32324	do	Gadsden.
Bickerstaff Clay Products Co.	Box 1178 Columbus, Ga. 31902	Open-pit mine and plant	Escambia.
Florida Solite Co	Box 297 Green Cove Springs, Fla. 32043	do	Clay.
General Portland Cement Co.	Box 1528 Tampa, Fla. 33601	Open-pit mine	Citrus.
Gypsum, calcined:			
Kaiser Gypsum Co., Inc	300 Lakeside Drive Oakland, Calif. 94612	Plant	Duval.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	do	Hillsborough.
U.S. Gypsum Co	101 South Wacker Drive Chicago, Ill. 60606	do	Duval.
Lime:			
Primary:			
Basic Magnesia, Inc	Box 160 Port St. Joe, Fla. 32456	do	Gulf.
Chemical Lime, Inc	Box 250 Ocala, Fla. 32670	do	Hernando.
Dixie Lime & Stone Co	Box 910 Ocala, Fla. 32670	do	Sumter.
Regenerated:			
Buckeye Cellulose Corp	Foley, Fla. 32347	Plant	Taylor.
Hudson Pulp & Paper Corp	Palatka, Fla. 32077	do	Putnam.
International Paper Co	Box 2487 Panama City, Fla. 32402	do	Bay.
St. Joe Paper Co	Port St. Joe, Fla. 32456	do	Gulf.
St. Regis Paper Co	Box 18020 Jacksonville, Fla. 32229	2 plants	Duval and Escambia.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Magnesium compounds: Basic Magnesia, Inc.	Box 160 Port St. Joe, Fla. 32456	Plant	Gulf.
Peat:			
Florahome Peat Humus	Florahome, Fla. 32635	Mine	Putnam.
Jack O. Holmes, Inc	Box 17157 Tampa, Fla. 33612	do	Orange.
Oxford Peat Co	Box 154 Oxford, Fla. 32684	do	Sumter.
F. E. Stearns Peat	Rt. #1 Box 347-1 Valrico, Fla. 33594	do	Hillsborough.
Traxler Peat Co	Box 86 Florahome, Fla. 32635	do	Putnam.
Perlite, expanded:			
Airlite Processing Corp	Bldg. 9, Air Base Vero Beach, Fla. 32960	Plant	Indian River.
Chemrock Corp	End of Osage St. Nashville, Tenn. 37208	do	Duval.
W. R. Grace & Co	62 Whittmore Ave. Cambridge, Mass. 02140	do	Dade.
Petroleum:			
Humble Oil & Refining Co	Box 2024 Houston, Tex. 77001	Sunniland field	Collier.
Sun Oil Company	Box 2880 Dallas, Tex. 75221	Sunoco-Felda field	Collier and Hendry.
Phosphate rock:			
Land-pebble:			
Agrico Chemical Co	5050 Poplar Ave. Memphis, Tenn. 38117	3 open-pit mines and plants	Polk.
American Cyanamid Co	Berdan Ave. Wayne, N.J. 07472	do	Hillsborough and Polk.
International Minerals & Chemicals Corp.	Old Orchard Road Skokie, Ill. 60079	do	Polk.
Mobil Chemical Co	Box 1136 Richmond, Va. 23208	do	Do.
Swift & Co	Box 208 Bartow, Fla. 33830	2 open-pit mines and plants	Do.
Soft-rock:			
Howard Phosphate Co	Box 13800 Orlando, Fla. 32809	Open-pit mine	Citrus.
Kellogg Co	Box 218 Hernando, Fla. 32642	do	Do.
Loncala Phosphate Co	Box 766 High Springs, Fla. 32643	2 open-pit mines	Marion and Gilchrist.
Soil Builders, Inc	Box 368 Dunnellon, Fla. 32630	Open-pit mine	Citrus.
Sun Phosphate Co	Box 523 Ocala, Fla. 32670	do	Do.
Phosphorus, elemental:			
Agrico Chemical Co	5050 Poplar Ave. Memphis, Tenn. 38117	3 electric furnaces	Polk.
Mobil Chemical Co	Box 1136 Richmond, Va. 23208	Electric furnace	Do.
Stauffer Chemical Co	299 Park Ave. New York, N.Y. 10017	do	Pinellas.
Rare-earth metal concentrates:			
National Lead Co	Room 1900, 111 Broadway New York, N.Y. 10006	Plant	Duval.
Sand and gravel:			
All Florida Sand Co	Box 4667 Jacksonville, Fla. 32201	Open-pit mine	Clay.
Gall Silica Mining Co	Box 987 Lake Wales, Fla. 33853	do	Polk.
E. R. Jahna Industries, Inc	First & East Tillman Lake Wales, Fla. 33853	do	Lake.
Orange Sand Co	Box 4667 Jacksonville, Fla. 32204	do	Do.
Standard Sand & Silica Co	Box 35 Davenport, Fla. 33837	do	Polk.
Staurolite: E. I. du Pont de Nemours & Co., Inc.	Du Pont Building Wilmington, Del. 19898	Plant	Clay.
Stone:			
Limestone, crushed:			
Dixie Lime & Stone Co	Box 910 Ocala, Fla. 32670	9 quarries	Alachua, Citrus, Hernando, Jackson, Levy, Marion, Sumter.
Florida Rock Products Corp.	Box 4667 Jacksonville, Fla. 32201	2 quarries	Hernando and Suwannee.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone, crushed—Continued			
Houdaille-Duval Wright Co.	Box 1588 Jacksonville, Fla. 32201	5 quarries	Alachua, Broward, Dade.
Maule Industries, Inc.	Box 2601 Hialeah, Fla. 33012	2 quarries	Broward and Dade.
Seminole Rock Products, Inc.	Box 543 Miami, Fla. 33144	Quarry	Dade.
Limestone, dimension:			
Bradenton Stone Co.	Box 1220 Bradenton, Fla. 33506	do	Manatee.
Oystershell:			
Bay Dredging & Construction Co.	Box 1484 Tampa, Fla. 33601	Dredge	Hillsborough.
Benton & Co., Inc.	Box 1347 St. Petersburg, Fla. 33731	do	Pinellas.
Fort Myers Shell & Dredging Co., Inc.	Box 973 Fort Myers, Fla. 33902	do	Lee.
Houdaille-Duval Wright Co.	Box 1588 Jacksonville, Fla. 32201	do	Duval.
Radcliff Materials, Inc.	Mobile, Ala. 36601	do	Walton.
Titanium concentrates: E. I. du Pont de Nemours & Co., Inc.	Du Pont Building Wilmington, Del. 19898	2 mines and plants	Clay.
Vermiculite, exfoliated:			
W. R. Grace & Co.	62 Whittmore Ave. Cambridge, Mass. 01109	3 plants	Duval, Hillsborough, Palm Beach.
Verlite Co.	Box 11385 Tampa, Fla. 33610	Plant	Hillsborough.
Zirconium concentrates:			
E. I. du Pont de Nemours & Co., Inc.	Du Pont Building Wilmington, Del. 19898	do	Clay.
National Lead Co.	Room 1900, 111 Broadway New York, N. Y. 10006	do	Duval.

The Mineral Industry of Georgia

This chapter has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Georgia.

By Robert G. Hobbs [1] and J. H. Auvil, Jr. [2]

Total value of mineral production for 1968 showed an increase of almost 13 percent over that of 1967. However in terms of 1957–59 constant dollars, the increase was only 6 percent. The major contributors to this increase were the clay and stone industries, which accounted for nearly 51 percent and 32 percent of the total production value, respectively.

Nonmetallic minerals in 1968 provided almost 98 percent of the total value compared with nearly 97 percent in 1967. Metals and peat accounted for the balance, slightly over 2 percent.

Georgia led the Nation in the production of kaolin; it was second in fuller's earth, kyanite, rare-earth metals concentrates, and zirconium (zircon) concentrates; third in scrap mica and bauxite; and fourth in barite, feldspar, and titanium (ilmenite) concentrates.

The economy of Georgia continued to improve. All sectors, as indicated by table 3, with the exception of agriculture, showed gains. Private housing construction exceeded 1967 value by 35.4 percent. Declines in other private construction, however, reduced the overall gain to only 12 percent. The net gain in construction values is reflected in the increased construction minerals production. Personal income data, total and per capita, showed increases. However, these were not corrected for inflationary trends. The State continued to rank 38th nationally in per capita income.

Legislation and Government Programs.—The Georgia Department of Mines, Mining and Geology continued its Minerals Ex-

Table 1.—Mineral production in Georgia [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite thousand short tons	W	W	140	$2,874
Clays do	4,953	$77,314	5,111	88,632
Iron ore (usable) thousand long tons, gross weight	267	1,450	192	1,119
Mica (scrap) short tons	17,158	291	W	W
Sand and gravel thousand short tons	3,787	4,206	3,803	4,314
Stone do	23,417	49,953	26,903	56,177
Talc short tons	46,150	292	45,600	288
Value of items that cannot be disclosed: Bauxite, cement, feldspar, kyanite, peat, rare-earth metals concentrates, titanium concentrates, zirconium concentrates, and values indicated by symbol W	XX	19,952	XX	19,686
Total	XX	153,458	XX	173,090
Total 1957-59 constant dollars	XX	[r] 142,788	XX	[p] 150,945

[p] Preliminary. [r] Revised. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

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[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.

[2] Director, Georgia Department of Mines, Mining and Geology, Atlanta, Ga.

ploration Program for phosphate, heavy minerals, clays, limestone, and industrial sand. This program included an air and ground radiometric survey conducted in the coastal areas for radioactive anomalies associated with heavy minerals. The 1968 session of the Georgia General Assembly passed the Surface Mining Act to regulate and control reclamation of surface-mined land. The Bureau of Mines completed sampling and laboratory testing of lightweight aggregate raw materials of the Appalachian Region, North Georgia.

The Interstate highway building program was a significant market for nonmetallic minerals (construction materials) produced in Georgia. At the end of 1968, a total of 650.5 miles (56.7 percent) of the planned Interstate System were completed and opened to traffic; 162.9 miles were under construction (14.2 percent), and 333.8 miles (29.1 percent) were yet to be built.

Table 2.—Value of mineral production in Georgia, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Baldwin	W	W	Kaolin.
Bartow	$3,969	$4,022	Barite, limestone, slate, iron oxide pigments, miscellaneous clay.
Bibb	W	602	Miscellaneous clay, sand and gravel.
Charlton	W	W	Ilmenite, zircon, monazite.
Chatham	W	W	Sand and gravel.
Chattooga	W	W	Marble.
Cherokee	W	W	Mica.
Clarke	W	W	Granite.
Clayton	W	W	Do.
Cobb	W	W	Do.
Columbia	W	W	Miscellaneous clay.
Cook	W	102	Sand and gravel.
Crawford	W	W	Do.
Dade	W	-------	
Decatur	W	W	Fuller's earth.
De Kalb	W	4,658	Granite, feldspar.
Dougherty	W	W	Sand and gravel.
Douglas	W	W	Granite.
Early	W	W	Limestone.
Effingham	W	W	Sand and gravel.
Elbert	W	W	Granite.
Evans	28	82	Sand and gravel.
Fannin	-------	81	Limsetone.
Fayette	W	W	Granite.
Floyd	W	W	Limestone, miscellaneous clay.
Fulton	6,053	9,936	Cement, granite, miscellaneous clay, sand and gravel.
Gilmer	W	W	Marble.
Glynn	W	W	Sand and gravel.
Gordon	15	24	Miscellaneous clay.
Greene	W	W	Sand and gravel.
Gwinnett	W	W	Granite.
Hall	W	W	Granite, limestone.
Hancock	-------	9	Granite.
Hart	W	W	Mica.
Henry	W	W	Granite.
Houston	W	W	Cement, limestone, miscellaneous clay.
Jasper	W	W	Feldspar.
Jefferson	1,232	855	Fuller's earth.
Jones	W	5,930	Kaolin, granite.
Lamar	W	W	Granite.
Lincoln	W	W	Kyanite.
Long	W	W	Sand and gravel.
Lowndes	W	W	Peat.
Madison	W	W	Granite.
Marion	W	-------	
Mitchell	W	W	Limestone.
Monroe	W	W	Granite.
Montgomery	20	20	Sand and gravel.
Murray	292	288	Talc.
Muscogee	W	W	Granite, sand and gravel.
Oglethorpe	878	2,018	Granite.
Pickens	W	W	Marble, sandstone.
Polk	W	W	Cement, slate, miscellaneous clay, sandstone.
Quitman	W	-------	
Rabun	W	W	Granite.
Richmond	4,284	4,517	Sandstone, kaolin, miscellaneous clay, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Georgia, by counties[1]—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Rockdale	W	W	Sand and gravel.
Spalding	W	W	Granite.
Stephens	W	W	Do.
Stewart	$902	$1,033	Iron ore.
Sumter	W	W	Kaolin, bauxite.
Talbot	W	526	Sand and gravel.
Taylor	W	W	Do.
Telfair	W	-------	
Thomas	W	3,387	Fuller's earth, sand and gravel.
Twiggs	W	W	Kaolin, fuller's earth.
Walker	W	780	Limestone, miscellaneous clay.
Ware	W	18	Sand and gravel.
Warren	W	W	Kaolin, granite.
Washington	28,573	34,314	Kaolin.
Webster	W	---------	
Whitfield	W	1,358	Limestone.
Wilkinson	14,694	W	Kaolin.
Undistributed	92,518	98,580	
Total [2]	153,458	173,090	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Appling, Atkinson, Bacon, Baker, Banks, Barrow, Ben Hill, Berrien, Bleckley, Brantley, Brooks, Bryan, Bulloch, Burke, Butts, Calhoun, Camden, Candler, Carroll, Catoosa, Chattahoochee, Clay, Clinch, Coffee, Colquitte, Coweta, Crisp, Dawson, Dodge, Dooly, Echols, Emanuel, Forsyth, Franklin, Glascock, Grady, Habersham, Haralson, Harris, Heard, Irwin, Jackson, Jeff Davis, Jenkins, Johnson, Lanier, Laurens, Lee, Liberty, Lumpkin, Macon, McDuffie, McIntosh, Meriwether, Miller, Morgan, Newton, Oconee, Paulding, Peach, Pierce, Pike, Pulaski, Putnam, Randolph, Schley, Screven, Seminole, Taliaferro, Tattnall, Terrell, Tift, Toombs, Towns, Treutlen, Troup, Turner, Union, Upson, Walton, Wayne, Wheeler, White, Wilcox, Wilkes, and Worth.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Selected economic indicators of Georgia business activity

	1967	1968	Change (percent)
Employment and labor force, annual average:			
Total work force available (thousands)	1,758.5	1,811.2	+3.0
Total unemployed (do.)	59.9	60.6	+1.2
Employment:			
Agricultural (thousands)	90.4	88.1	−2.5
Nonagricultural (do.)	1,387.2	1,427.0	+2.9
Mining (do.)	6.5	6.7	+3.1
Contract construction (do.)	74.8	77.8	+4.0
Service (excludes gas and sanitary) (do.)	156.4	167.0	+6.8
Government (all) (do.)	258.9	269.4	+4.1
Total manufacturing (do.)	437.2	449.2	+2.7
Personal income:			
Total (millions)	[r] $11,458	[p] $12,531	+9.4
Per capita	[r] $2,552	[p] $2,743	+7.5
Construction activity:			
Housing units—private:			
Number	31,008	38,128	+23.0
Value (millions)	$327.0	$442.8	+35.4
Total private construction (excluding private housing) (do.)	[r] $295.8	$254.9	−13.8
Cement shipments to and within Georgia:			
Portland (includes high early strength) (thousand 376-pound barrels)	9,436	8,602	−8.8
Masonry (thousand 280-pound barrels)	1,189	2,505	+110.7
New business incorporations	4,201	4,655	+10.8
Farm marketing receipts (millions)	$1,029.2	$1,025.9	−0.3
Mineral production (millions)	$153.5	$173.1	+12.8
Electrical energy-sales (millions kilowatt-hour)	23,229.3	26,291.3	+13.2
Export trading (millions)	$189.2	$229.6	+21.4
Import trading (do.)	$226.0	$259.8	+15.0

[r] Revised. [p] Preliminary.

Sources: U.S. Department of Commerce; Georgia Department of Labor; University of Georgia; Bureau of Mines.

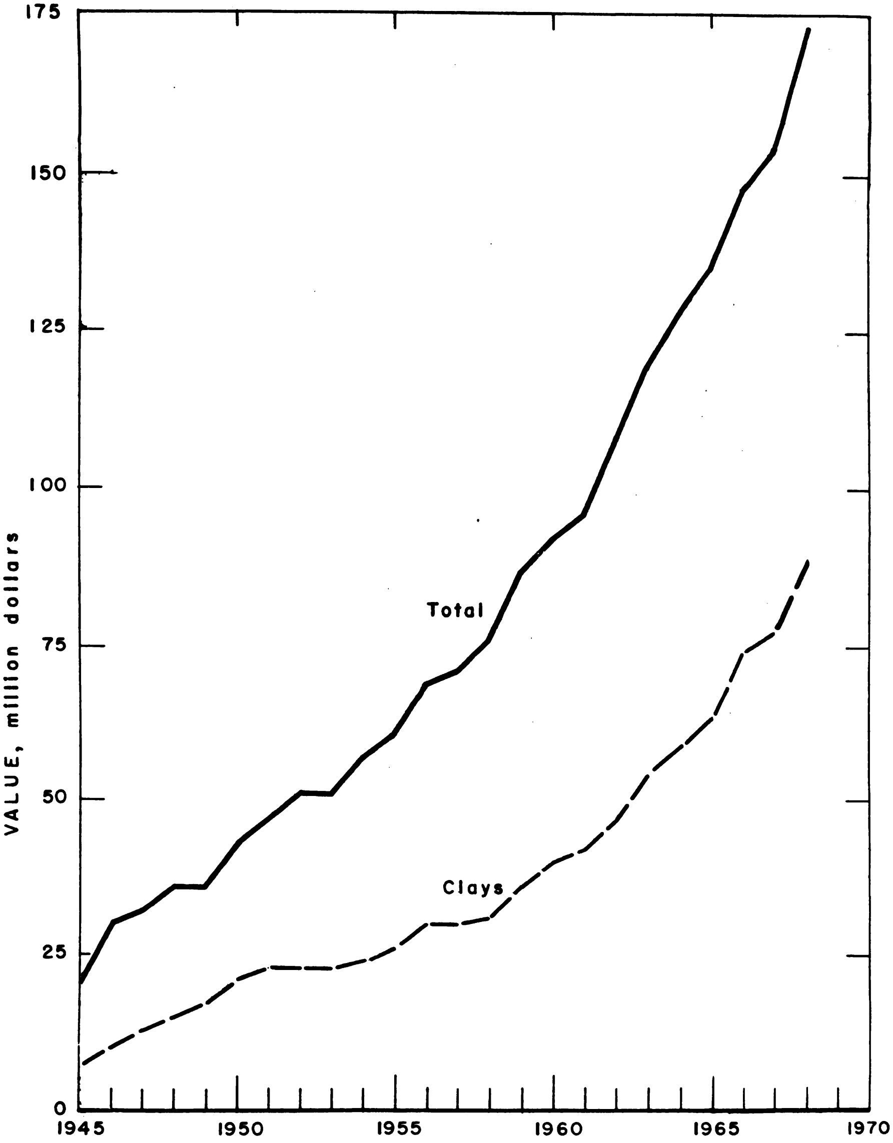

Figure 1.—Value of clays, and total value of mineral production in Georgia.

Table 4.—Worktime and injury experience in the mineral industry

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Metal	181	280	51	406	-------	11	27.07	276
Nonmetal and peat	4,000	288	1,153	9,334	-------	284	30.43	1,191
Sand and gravel	243	261	64	571	-------	15	26.26	527
Stone	2,980	259	771	6,445	-------	163	25.29	1,262
Total	7,404	275	2,038	16,756	-------	473	28.23	1,173
1968: p								
Metal	120	306	36	303	-------	7	23.10	548
Nonmetal and peat	3,490	302	1,055	8,480	-------	215	25.35	691
Sand and gravel	240	250	60	546	-------	10	18.32	771
Stone	3,035	264	800	6,913	2	121	17.79	2,308
Total	6,885	283	1,951	16,241	2	353	21.86	1,379

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Barite.—Four companies, all in the Cartersville district, Bartow County, produced primary barite in 1968. The major uses were in drilling muds and fillers (paint and rubber); barium chemicals and glass accounted for smaller amounts.

Cement.—Portland cement production, a major element of the State's industry, continued to rank third in total value. Seventy-eight percent of the shipments went to Georgia destinations, the balance to the bordering States and Mississippi. No masonry cement was produced in 1968.

Clays.—Clays ranked first in the State in terms of mineral production value, accounting for about 51 percent of the total. Kaolin made up about 62 percent of the total clay output and nearly 90 percent of the value. Seventeen companies produced kaolin from 27 mines in eight counties. Fuller's earth increased 17 percent in tonnage and 15 percent in value. Main uses were for absorbents and insecticides. It was mined by seven companies from seven mines in four counties. Miscellaneous clays were mined by 14 companies from 17 mines in 10 counties. Its main use was in brick manufacture.

Feldspar.—A feldspar concentrate, produced by flotation from feldspathic rock mined in Jasper County, was used principally in pottery, with lesser amounts in glass. A feldspar-silica flotation concentrates was produced as a byproduct at a crushed granite quarry at Lithonia, De Kalb County. The primary use of this concentrate was in glass manufacture. Although the tonnage produced was about the same as that in 1967, value decreased significantly.

Table 5.—Kaolin sold or used by producers, by counties

County	1967		1968	
	Number of mines	Thousand short tons	Number of mines	Thousand short tons
Twiggs	5	880	5	1,017
Washington	10	1,203	10	1,361
Wilkinson	6	578	5	W
Other counties [1]	7	349	7	787
Total [2]	28	3,009	27	3,165

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."

[1] Includes Baldwin, Jones (1968), Richmond, Sumter, Warren, and counties indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Gypsum.—Gypsum from out-of-State sources was calcined at three plants in Chatham and Glynn Counties for use in the manufacture of wallboard and other building materials.

Kyanite.—Production of kyanite in Lincoln County continued to increase and was 13 percent more than that of 1967. Its principal use was in refractories.

Table 6.—Kaolin sold or used by producers, by uses

(Thousand short tons)

Use	1967	1968
Pottery and stoneware:		
Whiteware	93	W
Refractories: Firebrick and block	278	209
Fillers:		
Paper filling	655	596
Paper coating	1,257	1,381
Rubber	101	94
Paint	105	120
Fertilizers	12	W
Portland and other hydraulic cements	55	W
Chemicals	W	32
Exports	203	287
Other uses [1]	249	445
Total [2]	3,009	3,165

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes stoneware; enameling; floor and wall tile; mortar; glass refractories; foundries, and steelwork (bulk); kiln furniture; other refractories; linoleum and oilcloth; insecticides and fungicides; plastics, organic; other fillers; catalysts (oil refining); other uses; and uses indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 7.—Miscellaneous clay sold or used by producers, by counties

County	1967		1968	
	Number of mines	Thousand short tons	Number of mines	Thousand short tons
Bartow	1	5	1	2
Fulton	3	321	4	W
Gordon	1	24	1	W
Other counties [1]	12	1,324	11	1,629
Total [2]	17	1,673	17	1,631

W Withheld to avoid disclosing individual company confidential data, included with "Other counties."

[1] Includes Bibb, Columbia, Floyd, Houston, Polk, Richmond, Walker, and counties indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Lime.—Regenerated lime showed a significant increase in 1968, increasing 55 percent in tonnage and 61 percent in value. Six companies with seven plants in six counties recovered and reused lime by burning in rotary kilns the calcium carbonate sludge formed in the pulp and paper manufacturing process.

Mica.—Scrap mica was produced by three companies, from three mines in Cherokee and Hart Counties. It was ground and used in joint cement, roofing, and the rubber and paint industries. Ground mica production increased in both tonnage and value.

Perlite.—Crude perlite, shipped into Georgia, was expanded for use principally in building plaster, concrete aggregate, and horticultural applications; production and value increased over those of 1967.

Sand and Gravel.—Sand and gravel continued to rank fourth in value in the State's mineral production. The quantity produced was about the same as that of 1967, but value increased 3 percent. The greatest use was in construction-concrete aggregates. Production by 21 companies was from 24 pits in 19 counties. Sand was produced at all locations; both sand and gravel were produced by three companies from three pits in three counties. One plant produced more than 600,000 tons in 1968, six plants between 200,000 and 400,000 tons, five between 100,000 and 200,000 tons, and 12 plants produced less than 100,000 tons each.

Stone.—Stone ranked second in value of production and accounted for about 32 percent of the State's total mineral value. Crushed granite was produced by 10 companies, with 26 quarries in 19 counties; 83 percent was transported by truck, the balance by rail. Dimension granite was produced by 25 companies from 30 quarries in five counties. Much of the monumental granite was shipped out of State.

Crushed limestone was produced by 11 companies and two governmental agencies from 13 quarries in nine counties. The three leading counties were Early, Floyd, and Whitfield. Trucks transported 78 percent and rail 22 percent of the produced tonnage.

Crushed marble, used primarily for agstone, fillers, and whiting, was produced by two companies from seven quarries in three counties. Both tonnage and value increased over that of 1967. About 79 percent of the production was moved by rail and 21 percent by truck. One company produced dimension marble. Although production was somewhat higher, value decreased. Cut stone, veneer, and rough stone were the main uses.

One company produced crushed sandstone in Polk County and another produced quartzite in Richmond County. Both tonnage and value increased. Main uses were for concrete aggregates and railroad ballast. Trucks moved 70 percent of the output, and 30 percent was shipped by rail.

Table 8.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1967			1968		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Cook	1	W	W	1	185	$102
Evans	1	19	$28	1	21	32
Greene	1	100	W	1	W	W
Montgomery	1	20	20	1	27	20
Muscogee	2	W	W	1	174	335
Talbot	2	W	W	2	655	526
Ware	1	W	W	1	27	18
Undistributed [1]	18	3,648	4,158	16	2,764	3,281
Total	27	3,787	4,206	24	3,803	4,314

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes Bibb, Chatham, Crawford, De Kalb (1967), Doughterty, Effingham, Fulton, Glynn, Long, Richmond, Rockdale, Taylor, Telfair (1967), Thomas, and counties indicated by symbol W.

Table 9.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967			1968		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	2,852	$2,558	$0.90	2,989	$2,785	$0.93
Paving	493	341	.69	439	331	.75
Fill	W	W	W	36	31	.86
Foundry	-----	-------	-------	10	10	1.00
Other uses [1]	442	1,307	2.96	329	1,157	3.52
Total sand and gravel	3,787	4,206	1.11	3,803	4,314	1.13

W Withheld to avoid disclosing individual company confidential data; included with "Total sand and gravel."

[1] Includes glass, molding, blast, engine, filtration and other sands; structural, paving (1967), fill gravel, and uses indicated by symbol W.

Table 10.—Crushed granite sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967			1968		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roadstone	15,357	$22,070	$1.44	17,690	$25,285	$1.43
Railroad ballast	W	W	W	976	1,279	1.31
Other uses [1]	1,976	2,811	1.42	758	1,530	2.02
Total [2]	17,333	24,881	1.44	19,423	28,095	1.45

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes stone sand, poultry grit, filter stone, riprap, roofing granules (1968), and blasting sand (1968).

[2] Data may not add to totals shown because of independent rounding.

Table 11.—Dimension granite sold or used by producers, by counties

County	1967				1968			
	Number of quarries	Thousand cubic feet	Short tons (equivalent)	Value (thousands)	Number of quarries	Thousand cubic feet	Short tons (equivalent)	Value (thousands)
De Kalb	5	739	59,139	$943	4	W	W	W
Elbert	13	450	36,018	1,313	13	408	36,062	$1,433
Hancock	-------	-------	-------	-------	1	4	374	9
Oglethorpe	9	W	W	W	10	423	39,777	2,018
Other counties [1]	2	709	56,660	1,898	2	1,039	86,891	2,570
Total [2]	29	1,898	151,812	4,154	30	1,873	163,104	6,029

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."

[1] Includes Madison County and counties indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 12.—Dimension granite sold or used by producers, by uses

(Thousand cubic feet and thousand dollars)

Use	1967			1968		
		Value			Value	
	Quantity	Total	Average per cubic foot	Quantity	Total	Average per cubic foot
Rough monumental	943	$2,091	$2.22	1,057	$3,067	$2.90
Dressed monumental	197	1,120	5.68	137	1,609	11.75
Rubble	W	W	W	404	139	.34
Other uses [1]	757	943	1.25	275	1,215	4.42
Total [2]	1,898	4,154	2.19	1,873	6,029	3.22

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes rough construction, architectural stone, curbing, and flagging (1967).

[2] Data may not add to totals shown because of independent rounding.

Table 13.—Crushed limestone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967			1968		
		Value			Value	
	Quantity	Total	Average per ton	Quantity	Total	Average per ton
Concrete and roadstone	2,332	$3,518	$1.51	3,022	$4,576	$1.51
Agstone	201	385	1.92	212	403	1.90
Other uses [1]	967	1,451	1.50	1,354	1,903	1.41
Total [2]	3,500	5,354	1.53	4,587	6,882	1.50

[1] Includes cement, riprap (1967), and fluxing stone.

[2] Data may not add to totals shown because of independent rounding.

Three companies quarried dimension sandstone in Pickens County for use as flagging and irregularly shaped rough blocks for construction. Both tonnage and value increased.

Crushed slate, for use in the manufacture of roofing granules and expanded lightweight aggregates, was produced by two companies, from two quarries and plants in Bartow and Polk Counties. Both tonnage and value increased.

Talc.—Talc was produced by one company from six mines in Murray County. Ground talc was used as a filler for asphalt, insecticides, roofing, and textiles.

METALS

Bauxite.—Bauxite production decreased significantly. All production came from two mines in Sumter County.

Iron Ore.—Output of iron ore decreased considerably in 1968. Only three mines in Stewart County were active. In 1967 there were 15 operations in six counties. The ore produced from open-pit mines was shipped to Birmingham and Gadsden iron and steel plants. One company produced iron oxide pigments from open-pit mines; both tonnage and value increased over that of 1967.

Rare-Earth Minerals.—Monazite concentrate was obtained as a coproduct at the Humphreys Mining Co.'s plant near Folkston.

Titanium.—Humphreys Mining Co. continued to produce ilmenite concentrate at its dredge and plant in south Georgia in Charlton County.

Zirconium.—Zircon was concentrated as a coproduct at Humphreys Mining Co. plant near Folkston.

FUELS

Peat.—Two companies produced humus and reed-sedge peat; both tonnage and value decreased 29 percent from that of 1967. The main uses of this product were for soil conditioner and flower packing.

Table 14.—Principal producers

Commodity and company	Address	Type of activity	County
Barite, primary:			
Cain Mining Co	Box 304 Cartersville, Ga. 30120	Open-pit mine	Bartow.
Milchem, Inc	3920 Essex Lane Houston, Tex. 77027	do	Do.
New Riverside Ochre Co	Box 387 Cartersville, Ga. 30120	do	Do.
Paga Mining Co	Cartersville, Ga. 30120	Open-pit mine and grinding mill	Do.
Bauxite: American Cyanamid Co.	Berdan Ave. Wayne, N.J. 07472	Open-pit mine and drying plant.	Sumter.
Cement, portland:			
Marquette Cement Manufacturing Co.	20 N. Wacker Dr. Chicago, Ill. 60606	Plant	Polk.
Penn-Dixie Cement Corp	Box 152 Nazareth, Pa. 18064	do	Houston.
Southern Cement Co	16th Floor Bank for Savings Bldg. Birmingham, Ala. 35203	do	Fulton.
Clay:			
Fuller's earth:			
Cairo Production Co., Inc.	Box 358 Cairo, Ga. 31728	Open-pit mine	Thomas.
Englehard Minerals & Chemicals Corp.	Menlo Park Edison, N.J. 08817	do	Decatur.
Georgia-Tennessee Mining & Chemical Co.	Box 307 Wrens, Ga. 30833	do	Jefferson.
General Reduction Corp	212 W. Monroe Chicago, Ill. 60606	do	Twiggs.
Waverly Mineral Products Co.	Meigs, Ga. 31765	do	Thomas.
Kaolin:			
American Industrial Clay Co. of Sandersville.	Sandersville, Ga. 31082	2 open-pit mines	Warren and Washington.
Engelhard Minerals & Chemicals Corp.	Menlo Park Edison, N.J. 08817	do	Washington and Wilkinson.
Freeport Kaolin Co	405 Lexington Ave. New York, N.Y. 10017	do	Jones and Twiggs.
Georgia Kaolin Co	433 North Broad St. Elizabeth, N.J. 07208	Open-pit mine	Twiggs.
J.M. Huber Corp	630 3d Ave. New York, N.Y. 10017	2 open-pit mines	Twiggs and Warren.
Miscellaneous:			
Burns Brick Co	Box 4787 Macon, Ga. 31208	Open-pit mine	Bibb.
Chattahoochee Brick Co	3195 Brick Plant Rd. Atlanta, Ga. 30321	3 open-pit mines	Floyd (1) and Fulton (2).
Cherokee Brick & Tile Co.	Box 4567 Macon, Ga. 31208	Open-pit mine	Bibb.

Table 14.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays—Continued			
Miscellaneous—Continued			
Georgia-Carolina Brick & Tile Co.	Route 1, Box 10 Augusta, Ga. 30906	do	Richmond.
Merry Brothers Brick & Tile Co.	415 Masonic Bldg. Augusta, Ga. 30902	do	Do.
Feldspar, crude:			
The Feldspar Corp	Spruce Pine, N.C. 28777	Open-pit mine and flotation plant.	Jasper.
Georgia Marble Co	Lithonia, Ga. 30058	Flotation plant	De Kalb.
Gypsum, calcined:			
The Flintkote Co	480 Central Ave. East Rutherford, N.J. 07073	Plant	Chatham.
Georgia-Pacific Corp	Commonwealth Bldg. Portland, Oreg. 97207	do	Glynn.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	do	Chatham.
Iron ore:			
Davis Bros	Brantley, Ala. 36009	Open-pit mine	Stewart.
Lumpkin Mining Co	Box 234 Greenville, Ala. 36037	do	Do.
Pigeon Creek Mining Co	Lumpkin, Ga. 31815	do	Do.
Iron oxide pigment materials: New Riverside Ochre Co.	Box 387 Cartersville, Ga. 31020	do	Bartow.
Kyanite: Aluminum Silicates, Inc.	Box 649 Washington, Ga. 30673	Open-pit mine and mill.	Lincoln.
Lime, regenerated:			
Brunswick Pulp & Paper Co.	Brunswick, Ga. 31520	Plant	Glynn.
Continental Can Co., Inc	Old Savannah Rd. Augusta, Ga. 30901	do	Richmond.
	Port Wentworth, Ga. 31407	do	Chatham.
Gilman Paper Co	St. Mary's, Ga. 31558	do	Camden.
Rayonier, Inc	Jesup, Ga. 31545	do	Wayne.
Union-Camp Corp	Box 570 Savannah, Ga. 31402	do	Chatham.
Mica, scrap:			
Franklin Mineral Products Co.	Box 0 Wilmington, Mass. 01887	Open-pit mine and grinding mill.	Hart.
Glenn-Ray Corp	Box 278 Chatsworth, Ga. 30705	Undgerground mine	Cherokee.
Thompson-Weinman & Co	Cartersville, Ga. 30120	Underground mine and grinding mill.	Cherokee and Bartow.
Peat:			
Georgia Peat Moss Co	Route 2 Lake Park, Ga. 31636	Open-pit mine	Lowndes.
Lake Park Peat Moss Co	Lake Park, Ga. 31636	do	Do.
Perlite, expanded: W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Plant	Fulton.
Rare-earth metals: Humphreys Mining Co.	Box 8 Folkston, Ga. 31537	Dredge and plant	Charlton.
Sand and gravel:			
Atlanta Sand & Supply Co	605 Forsyth Bldg. Atlanta, Ga. 30303	Open-pit mine	Crawford.
Dawes Silica Mining Co., Inc.	Drawer 920 Thomasville, Ga. 31792	4 open-pit mines	Dougherty, Effingham Long, and Thomas.
Drake Eye Mining Co	Box 236 Lithonia, Ga. 30058	Open-pit mine and dredge.	Rockdale.
Howard Sand Co	Howard, Ga. 31039	Open-pit mine	Taylor.
Taylor County Sand Co	Junction City, Ga. 31812	do	Talbot.
Stone:			
Granite, crushed:			
Dixie Lime & Stone Co	Box 910 Ocala, Fla. 32670	5 quarries	Clayton, Fayette, Lamar, Monroe, and Spalding.
Hitchcock Corp	Box 35 Murphy, N.C. 28906	3 quarries	Clayton, Fulton, and Jones
Stone Mountain Grit Co., Inc.	Box 458 Lithonia, Ga. 30058	2 quarries	De Kalb and Fulton.
Vulcan Materials Co	Box 12078, N. Side Station Atlanta, Ga. 30305	6 quarries	Cobb, Douglas, Fulton Gwinnett Henery and Muscogee.

Table 14.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone, crushed—Continued			
Weston & Brooker Co.	Box 335 Gray, Ga. 31032	Quarry	Jones.
	Box 180 Thomas, Ga. 30824	do	Warren.
Granite, dimension:			
Bennie & Harvey	Box 958 Elberton, Ga. 30635	do	Oglethorpe.
Coggins Granite Industries, Inc.	Box 250 Elberton, Ga. 30635	2 quarries	Elbert and Madison.
Davidson Granite Co., Inc.	Lithonia, Ga. 30058	Quarry	De Kalb.
Georgia Marble Co.	Elberton, Ga. 30635	2 quarries	Elbert and Madison.
Stone Mountain Granite Co.	Stone Mountain, Ga. 30083	Quarry	De Kalb.
Limestone, crushed:			
Dalton Rock Products Co.	Box 1608 Dalton, Ga. 30720	do	Whitfield.
Georgia Rock Products Co.	Arlington, Ga. 31713	do	Early.
Lambert & Lambert Stone Co., Inc.	Box 2098 Chattanooga, Tenn. 37409	do	Walker.
Penn-Dixie Cement Corp.	Box 152 Nazareth, Pa. 18064	Quarry	Houston.
Ready-Mix Concrete Co., Inc.	401 E. 1 st Ave. Rome, Ga. 30161	do	Floyd.
Marble, crushed:			
Georgia Marble Co.	Tate, Ga. 30177	4 quarries	Gilmer and Pickens.
Marble Products Co.	67 Peachtree Park Drive Atlanta, Ga. 30309	2 quarries	Chattooga and Pickens.
Marble, dimension: Georgia Marble Co.	Tate, Ga. 30177	Quarry and finishing plant.	Pickens.
Sandstone, crushed:			
Marquette Cement Manufacturing Co.	20 N. Wacker Dr. Chicago, Ill. 60606	Quarry	Polk.
Superior Stone Co.	Box 2568 Raleigh, N.C. 27602	Quartzite quarry	Richmond.
Sandstone, dimension:			
Johnson, Carl S.	Route 1 Talking Rock, Ga. 30175	Quarry	Pickens.
Johnson, Hardy L.	Route 2 Jasper, Ga. 30143	do	Do.
North Georgia Stone Co.	Whitestone, Ga. 30186	2 quarries	Do.
Slate, crushed:			
General Aniline & Film Corp.	Fairmont, Ga. 30139	Underground quarry	Bartow.
Georgia Lightweight Aggregate Company	Box 19781, Station N Atlanta, Ga. 30325	Quarry and expanding plant.	Polk.
Talc: Georgia Talc Company	Box 278 Chatsworth, Ga. 30705	5 underground mines and 1 open-pit	Murray.
Titanium concentrates: Humphreys Mining Co.	Box 8 Folkston, Ga. 31537	Dredge and plant	Charlton.
Vermiculite, exfolidated: W.R. Grace & Co	62 Whittemore Ave. Cambridge, Mass. 02140	Plant	Fulton.
Zirconium concentrates: Humphreys Mining Co.	Box 8 Folkston, Ga.	Dredge and plant	Charlton.

The Mineral Industry of Hawaii

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Hawaii Department of Land and Natural Resources for the collection of mineral data.

By Roy Y. Ashizawa [1]

Heavy construction activity in 1968 accelerated Hawaii's mineral output value to a new high of $23.2 million. Demand for cement, sand, crushed stone, pumice, volcanic cinder, and clay products for building and paving uses were at record levels. Significant increases also occurred in the production of lime for the sugar mills, black coral for costume jewelry, and crude salt for local consumption.

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[1] Mineral specialist, Bureau of Mines, San Francisco, Calif.

Table 1.—Mineral production in Hawaii [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement ---- thousand 376-pound barrels	1,395	$7,360	1,841	$9,254
Clay ---- thousand short tons	W	W	3	4
Lime ---- do	8	265	8	268
Pumice, pumicite, and volcanic cinder ---- do	290	562	408	724
Sand and gravel ---- do	469	1,467	546	1,653
Stone ---- do	4,100	7,207	5,211	11,273
Value of items that cannot be disclosed:				
Gem stones, salt, and values indicated by symbol W	XX	75	XX	49
Total	XX	16,936	XX	23,225
Total in 1957–59 constant dollars	XX	[r] 16,337	XX	[p] 22,279

[p] Preliminary. [r] Revised. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Hawaii, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968, in order of value
Hawaii	$2,097	$2,089	Stone, pumice and volcanic cinder.
Honolulu	12,693	18,481	Cement, stone, lime, clays, salt.
Kauai	712	419	Stone, sand and gravel, volcanic cinder.
Maui	1,434	2,236	Sand and gravel, stone, volcanic cinder, lime, gem stones.
Total	16,936	23,225	

Table 3.—Economic indicators

	1967 r	1968 p
Employment............thousands..	281.1	291.5
Personal income:		
Total............millions..	$2,415.0	$2,706.0
Per capita............	$3,242.0	$3,514.0
Construction:		
Completed............millions..	$367.0	$442.0
Building permits on Oahu............do....	$210.4	$322.0
Manufacturing............do....	$310.0	$344.0
Sugar............do....	$190.9	$209.0
Pineapple............do....	$133.3	$127.6
Mineral production............do....	$16.9	$23.2
Defense expenditures............do....	$584.8	$610.0
Visitors:		
Arrivals............thousands..	1,001.8	1,200.0
Expenditures............millions..	$400.0	$500.0

p Preliminary. r Revised.
Sources: Survey of Current Business, Hawaii Department of Labor and Industrial Relations, Hawaii Visitors Bureau, Hawaii Department of Taxation, Honolulu Building Department, Bank of Hawaii, and First Hawaiian Bank.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Nonmetal............	111	81	9	70	-------	-------	-------	-------
Sand and gravel......	21	155	3	26	-------	1	38.44	884
Stone............	527	240	126	1,035	-------	33	31.88	678
Total [1]............	659	210	139	1,131	-------	34	30.06	637
1968: p								
Nonmetal............	100	88	9	71	-------	1	14.17	218
Sand and gravel......	30	90	3	22	-------	-------	-------	-------
Stone............	495	234	115	940	-------	40	42.56	1,608
Total............	625	203	127	1,033	-------	41	39.70	1,474

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Two producers on Oahu shipped a record 1,841,000 barrels of portland cement, 1,812,000 barrels for use in Hawaii and 29,000 barrels for export. More than 74 percent of the total went to ready-mixed concrete companies, 14 percent to concrete product manufacturers, 6 percent to building material dealers, 4 percent to contractors, and 2 percent to government agencies and miscellaneous customers. Total consumption of cement in Hawaii, including receipts of 72,000 barrels from the U.S. mainland and 2,000 barrels from Japan, reached an alltime high of 1,887,000 barrels.

Local raw materials used in the production of cement were 378,000 tons of coral limestone and 72,000 tons of basalt. Silica sand, gypsum, iron ore, and grinding aids were imported. The two plants used 45.8 million kilowatt-hours of electrical energy.

Kaiser Cement & Gypsum Corp. planned to utilize a special barge for shipments of cement from Oahu and to expand the capacities of the distribution terminals on the outer islands of Hawaii. The barge was formerly used by the company to transport cement on the Columbia River inland waterway in Washington.

Clays.—The State's sole producer of red building brick and tile operated a plant on

Oahu at Barbers Point, utilizing clays mined near Waimanalo. The quantity of clays used during 1968 was appreciably above that in 1967.

Gem Stones.—Scuba divers worked the deep channel waters off Maui to gather black coral gem material. Lapidaries and jewelers cut and polished the coral into a variety of free-form shapes for mounting in rings, brooches, and earrings. Hawaiian black coral jewelry was reportedly the most popular gift item purchased by tourists.

Souvenir shops continued to sell other gem jewelry identified as Pele's Tears, Maui Moonstone, and Hawaiian Olivine. The sizes, colors, and characteristics of these gem stones were similar to the Apache tears (obsidian), Arizona moonstone (chalcedony), and peridots (olivine) collected in Arizona and New Mexico. None of these gem stones is found in Hawaii in commercial quantities.

Lime.—An increase in production of quicklime and hydrated lime at plants on Oahu and Maui was attributed to higher demand by sugar mills for use in clarifying cane juice. Lime also was sold for use in masonry, water purification, sewage treatment, agriculture, and as a flux for melting scrap iron in an electric furnace by a manufacturer of reinforcing bars.

Pumice and Volcanic Cinder.—A record 407,700 tons of pumice and volcanic cinder was produced in 1968, with 35 percent of the total used for construction of secondary and tertiary roads, 31 percent for lightweight concrete aggregate, 30 percent for landscaping, and 4 percent for horticultural and other decorative applications. Concrete aggregate and landscaping uses of the material increased substantially. Large tonnages of pumice from the island of Hawaii and cinder from Molokai were barged to Oahu for use in concrete.

Salts.—Crude salt was produced commercially on Oahu near the Barbers Point barge harbor. Favorable weather conditions resulted in an increase in yield of the solar-evaporated salt. The product was bagged and sold for use in curing fish and seasoning meats.

Consumption of crude and refined salt in Hawaii, including receipts from mainland producers, amounted to nearly 4,000 tons. The mainland supplied salt for food and chemical processing, table salt, and block salt for livestock feed.

Sand and Gravel.—Production of coral sand and basaltic gravel at 14 locations on the islands of Kauai, Lanai, Maui, and Molokai, totaled 546,000 tons. Most of the sand mined on Molokai was barged for use on Oahu. Alluvial gravels were produced from the foothills near Waikapu on Maui.

The scarcity of sand in areas planned for resort development necessitated the reclamation of offshore sand deposits. At Keauhou on the island of Hawaii, Marine Advisors, Inc., utilized a suction dredge and pipeline to pump and convey sand to develop a beach and golf course. The company also explored the ocean bottom off Waikiki Beach on Oahu and found an estimated 1 million cubic yards of sand which could be used to replenish and widen the beach, which continually loses its sand to wave action and shifting ocean currents.

Stone.—Over 5.2 million tons of stone was quarried, of which 4.6 million tons was processed for use as concrete aggregate and base material. Nearly 82 percent of the total volume was produced on Oahu, 14 percent on Hawaii, and 4 percent of Kauai, Maui, and Molokai. The quarries yielded a record 3,781,000 tons of basalt, 930,000 tons of coral limestone, and 501,000 tons of aa, lava slabs, and moss rock. The substantial gain in basalt output occurred on Oahu, where newly modernized crushing plants were placed on stream at the Halawa and Kapaa facilities during 1968.

Vermiculite.—Crude vermiculite from Montana was expanded in a vertical exfoliating furnace on Oahu for lightweight aggregate, heat and acoustical insulation, and agricultural uses.

MINERAL FUELS

At Barbers Point on Oahu, Standard Oil Co. of California operated a refinery with a daily crude oil capacity of 35,000 barrels. Aviation and motor gasolines, jet fuel, diesel fuels, asphalts, and other products were produced from foreign crude for sale, under various brand names, in Hawaii and the Pacific islands. Local demand for petroleum products increased significantly during 1968. The largest gains were for jet fuel, liquefied gas, and asphalts.

Several newly formed ventures were conducting studies regarding the establishment of additional oil refineries in Hawaii. Hawaii Independent Refinery, Inc., planned to construct a $20 million refinery at Barbers Point with a crude oil capacity of 29,500 barrels per day. Dillingham Corp. and Continental Oil Co. planned to construct a $60 million refinery at Barbers Point with a capacity of 50,000 barrels of crude oil daily.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	Island
Cement:			
Hawaiian Cement Corp	1600 Kapiolani Blvd., Suite 1200 Honolulu, Hawaii 96814	Dry process portland cement plant.	Oahu.
Kaiser Cement & Gypsum Corp.	Permanente Rd. Permanente, Calif. 95014	Wet process portland cement plant.	Do.
Clays: Pacific Clay Corp	547 Halekauwila St. Honolulu, Hawaii 96813	Open-pit mine	Do.
Lime:			
GasprO, Ltd	P.O. Box 2454 Honolulu, Hawaii 96804	Rotary kiln and continuous hydrator	Do.
Hawaiian Commercial & Sugar Co.	Puunene, Hawaii 96784	do	Maui.
Pumice and volcanic cinder:			
Fong Construction Co., Ltd.	237 Dairy Rd. Kahului, Hawaii 96732	Open-pit mine	Do.
Grove Farm Co., Ltd	Puhi Rural Station Lihue, Hawaii 96766	do	Kauai.
Hawaiian Agricultural Co., Ltd.	Pahala, Hawaii 96777	do	Hawaii.
HC & D, Ltd	P.O. Box 190 Honolulu, Hawaii 96810	do	Molokai.
Hutchinson Sugar Co., Ltd	Naalehu, Hawaii 96772	do	Hawaii.
James Kuwana	P.O. Box 306 Pahoa, Hawaii 96778	do	Do.
McBryde Sugar Co., Ltd	Eleele, Hawaii 96705	do	Kauai.
Pepeekeo Sugar Co	Pepeekeo, Hawaii 96783	do	Hawaii.
Volcanite, Ltd	828 Fort St. Honolulu, Hawaii 96813	do	Do.
Salt: Tanaka Hawaiian Salt	968 D Akepo Lane Honolulu, Hawaii 96817	Solar evaporation	Oahu.
Sand and gravel:			
Concrete Industries, Inc	P.O. Box 86 Puunene, Hawaii 96784	Open-pit mine	Maui.
Hale Kauai, Ltd	Nawiliwili, Hawaii 96766	do	Kauai.
Hawaiian Commercial & Sugar Co., Ltd.	Puunene, Hawaii 96784	do	Maui.
HC & D, Ltd	P.O. Box 190 Honolulu, Hawaii 96810	do	Molokai.
Lihue Plantation Co., Ltd	P.O. Box 751 Lihue, Hawaii 96766	Open-pit mine	Kauai.
Maui Concrete & Aggregates, Inc.	8 Central Ave. Wailuku, Hawaii 96793	do	Maui.
Stone:			
Allied Aggregates Corp	2827 Kaihikapu St. Honolulu, Hawaii 96819	Open quarry	Oahu.
Concrete Industries, Inc	P.O. Box 86 Puunene, Hawaii 96784	do	Maui.
James W. Glover, Ltd	P.O. Box 275 Hilo, Hawaii 96720	do	Hawaii.
Grove Farm Co., Inc	Puhi Rural Station Puhi, Hawaii 96766	do	Kauai.
Hawaiian Agricultural Co., Ltd.	Pahala, Hawaii 96777	do	Hawaii.
Hawaiian Bitumuls & Paving Co., Ltd.	P.O. Box 2240 Honolulu, Hawaii 96804	do	Oahu.
Hawaiian Cement Corp	1600 Kapiolani Blvd., Suite 1200 Honolulu, Hawaii 96814	do	Do.
HC & D, Ltd	P.O. Box 190 Honolulu, Hawaii 96810	do	Do.
Honokaa Sugar Co	Haina, Hawaii 96709	do	Hawaii.
Joe's Moss Rock Co	1446 Meyers St. Honolulu, Hawaii 96819	do	Oahu.
Kaiser Cement & Gypsum Corp.	Permanente Rd. Permanente, Calif. 95014	do	Do.
Kauai Concrete & Aggregate Prod.	P.O. Box 98 Kapaa, Hawaii 96746	do	Kauai.

Table 5.—Principal producers—Continued

Commodity and company	Address	Type of activity	Island
Stone—Continued			
James Kuwana	P.O. Box 306 Pahoa, Hawaii 96778	Open quarry	Hawaii.
Kuwaye Brothers, Inc	P.O. Box 707 Hilo, Hawaii 96720	do	Do.
Laie Concrete & Aggregate, Inc.	Laie, Hawaii 96762	do	Oahu.
Laupahoehoe Sugar Co	Papaaloa, Hawaii 96780	do	Hawaii.
Moss Rock Hawaii	6154 A Kalanianaole Hwy. Honolulu, Hawaii 96821	do	Oahu.
Pacific Cement & Aggregates Co.	400 Alabama St. San Francisco, Calif. 94110	do	Do.
Pacific Concrete & Rock Co., Ltd.	2344 Pahounui Dr. Honolulu, Hawaii 96819	do	Do.
Puna Sugar Co., Ltd	Keaau Hawaii 96749	do	Hawaii.
J.M. Tanaka Construction, Inc.	P.O. Box 67 Kailua-Kona, Hawaii 96740	do	Do.
Walker-Moody Construction Co., Ltd.	2927 Mokumoa St. Honolulu, Hawaii 96819	do	Molokai.
Yamada Sons, Inc	P.O. Box 577 Hilo, Hawaii 96720	do	Hawaii.
Vermiculite (exfoliated): Vermiculite of Hawaii, Inc.	842-A Mapunapuna St. Honolulu, Hawaii 96819	Exfoliating plant	Oahu.

The Mineral Industry of Idaho

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Idaho Bureau of Mines and Geology for collecting information on all minerals except fuels.

Fred V. Carrillo,[1] Mary Anne McComb,[2] and Norman S. Petersen[3]

Idaho's mineral production rose $4.8 million (4.4 percent) in value in 1968, nearly recovering from the dip in value (4.8 percent) which occurred in 1967. As in the past, silver was the leading value product in the State's total mineral production of $114.3 million. The increase in silver production value (29.6 percent) was due entirely to the 1968 record average price of $2.14 per ounce as the total quantity of silver produced actually declined 6.3 percent.

The decline in silver production, as well as declines in the production of gold (33.3 percent), lead (10.7 percent), and copper (16.3 percent) was caused by a nationwide copper industry strike, which began in 1967 and continued for the first 3 months of 1968. Production of construction materials was mixed; cement and stone output increased, but sand and gravel output fell 26.9 percent compared with that of 1967.

The merger of The Bunker Hill Co. and Gulf Resources and Chemical Corp. was approved by the shareholders of the firms. The Bunker Hill Co. announced plans to construct an ammonium sulfate plant at its Kellogg smelter-fertilizer complex.

Table 1.—Mineral production in Idaho[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrate..short tons, antimony content..	823	W	853	W
Clays[2]..thousand short tons..	19	$16	12	$14
Copper (recoverable content of ores, etc.)..short tons..	4,210	3,219	3,525	2,950
Gem stones..	NA	180	NA	200
Gold (recoverable content of ores, etc.)..troy ounces..	4,838	169	3,227	[3]127
Gypsum..thousand short tons..	------	--------	3	13
Lead (recoverable content of ores, etc.)..short tons..	61,387	17,188	54,790	14,478
Mercury..76-pound flasks..	898	439	W	W
Peat..short tons..	2,040	16	W	W
Phosphate rock..thousand short tons..	W	W	3,879	22,721
Pumice..do..	W	W	135	259
Sand and gravel..do..	11,246	11,490	8,224	9,133
Silver (recoverable content of ores, etc.)..thousand troy ounces..	17,033	26,402	15,959	34,225
Stone..thousand short tons..	1,986	4,833	2,195	5,209
Tungsten ore and concentrate (60 percent WO_3 basis) short tons..	68	175	W	W
Zinc (recoverable content of ores, etc.)..do..	56,528	15,650	57,248	15,457
Value of items that cannot be disclosed: Cement, garnet (abrasive), iron ore, lime, perlite, vanadium, and values indicated by symbol W..	XX	29,631	XX	9,467
Total..	XX	109,408	XX	114,253
Total 1957–59 constant dollars..	XX	92,578	XX	[p] 88.933

[p] Preliminary. NA Not available. W Withheld to avoid disclosing company confidential data. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fire clay and kaolin; included with "Value of items that cannot be disclosed."

[3] Based on average U.S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968, and the New York selling price for the remainder of the year.

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[1] Geologist, Bureau of Mines, Albany, Oreg.

[2] Economist, Bureau of Mines, Albany, Oreg.

[3] Mineral specialist, Bureau of Mines, Albany, Oreg.

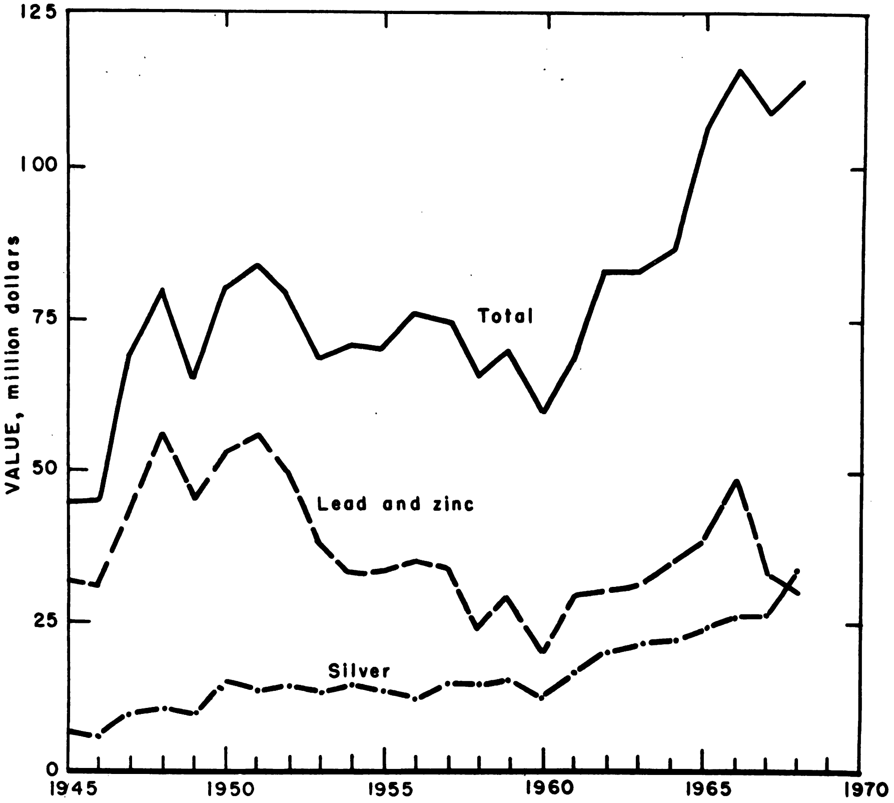

Figure 1.—Value of silver, lead and zinc, and total value of mineral production in Idaho.

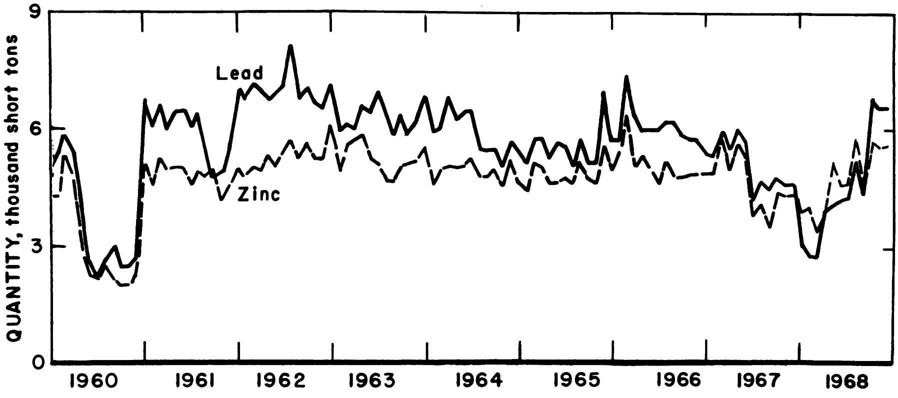

Figure 2.—Mine production of lead and zinc in Idaho, by months, in terms of recoverable metals.

Table 2.—Value of mineral production in Idaho, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Ada	$398	$436	Sand and gravel.
Adams	-------	42	Copper, sand and gravel, silver, gold.
Bannock	W	W	Cement, sand and gravel, stone, peat, copper, silver.
Bear Lake	229	267	Sand and gravel.
Benewah	W	W	Garnet and stone.
Bingham	W	W	Phosphate rock, vanadium, sand and gravel, clays.
Blaine	1,574	1,137	Silver, lead, zinc, sand and gravel, gold, copper.
Boise	54	118	Sand and gravel, gold, silver, zinc, lead.
Bonner	82	84	Stone, silver, lead, zinc, gold, copper.
Bonneville	725	734	Sand and gravel, lime, stone, pumice, clays.
Boundary	28	31	Sand and gravel.
Butte	W	108	Lead, sand and gravel, silver, zinc, copper, gold.
Camas	19	104	Sand and gravel, silver, zinc, lead, gold.
Canyon	1,221	1,031	Sand and gravel, lime, pumice.
Caribou	W	W	Phosphate rock, vanadium, stone, sand and gravel.
Cassia	979	107	Sand and gravel, clays, silver, gold, zinc.
Clark	16	94	Sand and gravel, lead, silver, zinc, copper.
Clearwater	1,605	1,889	Stone, sand and gravel.
Custer	1,051	1,506	Silver, lead, sand and gravel, zinc, copper, tungsten, gold.
Elmore	201	34	Sand and gravel, gold, silver.
Franklin	263	208	Sand and gravel.
Fremont	-------	17	Do.
Gem	239	220	Do.
Gooding	-------	226	Pumice, sand and gravel.
Idaho	237	111	Sand and gravel, stone, gold.
Jefferson	794	1,020	Sand and gravel, stone, clays.
Jerome	2,035	([2])	Gold, silver, lead.
Kootenai	165	412	Sand and gravel, stone.
Latah	1,540	W	Clays, stone, sand and gravel.
Lemhi	1,211	W	Copper, sand and gravel, gold, silver, lead, zinc.
Lincoln	168	W	Sand and gravel.
Minidoka	263	237	Lime, sand and gravel, clays.
Nez Perce	527	403	Sand and gravel.
Oneida	70	128	Sand and gravel, pumice, perlite.
Owyhee	-------	73	Sand and gravel, gold.
Payette	147	355	Sand and gravel, stone.
Power	92	16	Sand and gravel.
Shoshone	59,603	65,081	Silver, zinc, lead, copper, antimony, stone, sand and gravel, gold.
Teton	132	92	Sand and gravel.
Twin Falls	W	1,049	Sand and gravel, lime.
Valley	99	35	Tungsten, iron ore, mercury, stone, gold, silver.
Washington	945	689	Mercury, stone, iron ore, gypsum, sand and gravel, silver, copper, gold.
Undistributed [3]	32,696	36,159	
Total	109,408	114,253	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Lewis and Madison counties are not listed because no production was reported.

[2] Less than ½ unit.

[3] Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

A report which showed the relation of Idaho's mineral industry to the State's total economy was released. The report gave figures on taxes paid by the industry ($4.3 million), wages ($39.3 million), and out-of-State sales ($188.3 million). Figures were based on 1965 data.[4]

The FMC Corp. tripled phosphate rock unloading capacity at its Pocatello elemental phosphorus plant by installing a rotary railroad-car dumper at a cost of $1.5 million.

The 330-foot-high Hells Canyon Dam was completed at a cost of approximately $70 million; enough concrete was used in construction to have built a two-lane highway 340 miles long. The dam backs up water 23 miles to the Oxbow Dam.

Employment, Trade, and Markets.—Most key indicators of Idaho business activity rose during 1968. Total personal income and per capita personal income increased 6.5 and 6.3 percent, respectively. The volume of building permits issued—from selected canvassed areas—was down slightly. In terms of total employment, 1968 was

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[4] Newell, Merle L., and R. D. Peterson. Idaho's Minerals Industry: A Flow of Product Analysis. Idaho Bur. Mines and Geol., Pamph. 139, May 1968, 30 pp.

Table 3.—Indicators of Idaho business activity

	1967	1968 p	Change (percent)
Employment and labor force, annual average:			
Total labor force ... thousands	282.6	287.4	+1.7
Unemployment ... do	12.5	12.3	−1.6
Employment:			
Construction ... do	9.8	9.9	+1.0
Lumber and wood products ... do	11.7	12.6	+7.7
Food products ... do	13.2	14.1	+6.8
All manufacturing ... do	35.3	37.7	+6.8
All industries ... do	269.9	287.4	+6.5
Payrolls, factory ... millions	$209.7	$237.6	+13.3
Personal income:			
Total ... do	$1,800.0	$1,918.0	+6.5
Per capita	$2,567.0	$2,728.0	+6.3
Construction activity:			
Building permits ... millions	$42.2	(1)	--------
Heavy engineering awards ... do	$59.4	$45.5	−23.4
State Highway Commission:			
Value of contracts awarded ... do	$34.2	$28.3	−17.3
Value of contract work performed ... do	$27.5	$40.3	+46.5
Cement shipments to and within Idaho thousand 376-pound barrels	1,130.3	1,635.4	+44.7
Farm marketing receipts ... millions	$519.9	$529.2	+1.8
Mineral production ... do	$109.4	$114.3	+4.5

p Preliminary.

[1] Data no longer available. See text.

Sources: Survey of Current Business, Construction Review, Pacific Builder and Engineer, Idaho State Highway Commission, The Farm Income Situation, Idaho Labor Market, Labor Force and Employment in Idaho, Distribution by Industry of Wages Paid for Covered Employment in Idaho, and Bureau of Mines.

Table 4.—Annual employment and wages paid in the mineral industries

Year	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)
	MINING							
	Metals		Nonmetals		Fuels		Total	
1964	2,951	$18,310	327	$1,901	14	$82	3,292	$20,293
1965	2,935	18,563	540	3,431	3	11	3,478	22,005
1966	2,915	19,758	704	5,059	3	9	3,622	24,826
1967	2,718	20,089	637	4,432	3	8	3,358	24,530
1968	2,692	21,431	617	4,936	1	5	3,310	26,373
	MANUFACTURING							
	Stone and clay products		Primary metals		Phosphate fertilizers, elemental phosphorus, and sulfuric acid		Total	
1964	757	$4,138	1,032	$6,425	1,106	$8,086	2,895	$18,649
1965	854	5,210	1,296	8,234	1,245	9,042	3,395	22,486
1966	955	5,899	1,316	8,951	1,443	11,563	3,714	26,413
1967	930	5,959	1,302	9,850	1,490	12,613	3,722	28,422
1968	940	6,436	1,333	10,374	1,405	12,460	3,678	29,270

Source: Idaho Employment Security Agency; employment covered by unemployment insurance. Industry groups may not correspond with those in the Bureau of Mines canvass.

one of the State's best years; August had the second highest monthly total in Idaho history, 299,500, in spite of record rains. A primary reason for high employment was increased manufacturing, which was 13 percent above the 1960–68 October average and 26 percent higher than the 1950–58 October average, based on preliminary 1968 figures. October unemployment was at one of the lowest levels since 1958. Another contributing factor to high employment was a shift of the economic base away from farming; the agricultural labor force fell 1.2 percent, continuing a downward trend begun in 1958.

Table 5.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Nonfatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1967:								
Metal	2,521	237	598	4,782	7	242	52.07	11,638
Nonmetal and peat	726	233	169	1,396	------	28	16.48	345
Sand and gravel	188	174	33	264	------	5	18.94	788
Stone	327	120	39	327	------	7	21.42	1,441
Total	3,762	223	839	6,769	7	277	41.96	8,393
1968:^{p}								
Metal	2,455	243	598	4,778	4	261	55.46	8,928
Nonmetal and peat	515	236	122	1,082	------	25	24.28	1,571
Sand and gravel	350	180	63	505	------	11	21.79	1,085
Stone	200	176	36	298	------	6	20.12	902
Total [1]	3,525	232	818	6,613	4	308	46.42	6,820

^{p} Preliminary.

[1] Data may not add to totals shown because of independent rounding.

Table 6.—Hours and earnings of production workers in mining

Annual average	1964	1965	1966	1967	1968
Weekly earnings	$114.91	$116.22	$122.99	$136.52	$141.72
Hourly earnings	$2.88	$3.00	$3.18	$3.48	$3.58
Weekly hours	39.9	38.8	38.7	39.2	39.5

Source: Idaho Employment Security Agency.

Table 7.—Office of Minerals Exploration contracts active during 1968

County and contractor	Commodity	Contract: Date	Contract: Total amount	Contract: Government participation, percent
Custer:				
Beardsley Gulch Mining Co., Inc	Silver	July 14, 1966	$44,680	75
Owyhee:				
Continental Quicksilver, Inc.[1]	Gold and silver	Feb. 28, 1966	61,360	62.5
Sidney Mining Co.[1]	do	do	40,208	62.5

[1] In recess for all of 1968.

REVIEW BY MINERAL COMMODITIES

METALS

Antimony.—The Sunshine mine, near Kellogg, Shoshone County, continued to be the State's only source of antimony. The metal, a byproduct from silver ore, was leached from silver concentrates and recovered at the Sunshine Mining Co.'s electrolytic plant as cathode metal containing about 96 percent antimony. Yearly production of the metal increased 3.6 percent to 853 short tons.

Beryllium.—The Bureau of Mines published a 169-page report on beryllium deposits in the Northwest.[5] Among the areas included were Wild Horse, the Sawtooth and Trinity Mountains, and the Avon mica district in norther Idaho. Beryllium was found in low-grade quartz veins and idocrase tactites. Deposits of the latter were approximately 0.5 to 0.7 million tons, and the concentration was 0.033 to 0.080 percent beryllium oxide. The study was done as part of a nationwide study of the national beryllium supply. Increased demand had been anticipated in supersonic aircraft, missiles, nuclear reactors, and space vehicles.

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[5] Patee, Eldon C., Ronald M. Van Noy, and Robert D. Weldin. Beryllium Resources of Idaho, Washington, Montana, and Oregon. BuMines Rept. of Inv. 7148. 1968. 169 pp.

Copper.—A 16-percent decline in the production of copper resulted from continuation of the nationwide copper strike until April, the related strike at the Lucky Friday mine until mid-June, and the curtailment of production at the Blackbird mine during most of the year. Total production, largely a byproduct of silver production from Coeur d'Alene region mines, was 3,525 short tons.

Idaho Mining Co. continued a 2-year exploration and development program begun the previous summer at the Blackbird mine in Lemhi County. Production at the mine gave way to an expanded drilling program, resulting in only minor shipments of copper ore in 1968, compared with 26,150 tons shipped during the previous year.

Cordero Mining Co. rehabilitated old workings at the Beacon Light Mining Co.'s property east of Mullan. Work included retimbering of the portal, cleaning up a cave-in, retimbering a portion of the tunnel 150 feet from the portal, and placing new ladders in an old raise.

Gold.—Despite an increase in the average price of gold for the year to $39.26 per ounce, State output hit a record low of 3,227 ounces. The 33-percent decline in production from the previous record low in 1967 resulted from less byproduct gold from Coeur d'Alene region lead, zinc, and silver producers affected by the nationwide copper strike and from curtailed production of gold at the Lucky Friday mine in Shoshone County and the Blackbird mine in Lemhi County.

The increased price for gold spurred exploratory activity in the State. Several projects were initiated in the Murray Gold district north of Wallace. John Mock began a search for placer gold on the Salmon River, upstream from Lucile, using an underwater suction device.

Iron Ore.—All iron ore produced in the State was used in making cement. Output of iron ore increased 20 percent over that of 1967. The largest source continued to

Table 8.—Mine production of gold, silver, copper, lead, and zinc in terms of recoverable metals[1]

Year	Mines producing		Material sold or treated[2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1964	55	7	1,649	5,677	$199	16,483	$21,318
1965	70	5	1,783	5,078	178	18,457	23,865
1966	52	6	1,995	5,056	177	19,777	25,571
1967	52	2	1,773	4,838	169	17,033	26,402
1968	65	3	1,710	3,227	127	15,959	34,225
1863–1968[3]	--------	--------	153,350	8,336,111	194,917	856,983	725,364

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1964	4,666	$3,042	71,312	$18,684	59,298	$16,129	$59,367
1965	5,140	3,639	66,606	20,781	58,034	16,946	65,409
1966	4,961	3,589	72,334	21,867	60,997	17,689	68,898
1967	4,210	3,219	61,387	17,188	56,528	15,650	62,628
1968	3,525	2,950	54,790	14,478	57,248	15,457	67,237
1863–1968[3]	205,749	94,869	7,498,288	1,087,487	2,693,035	578,070	2,680,707

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings re-treated and ore, old slag, and mill cleanings shipped to smelters during the calendar year indicated. Data may not add to totals shown because of independent rounding.

[2] Does not include gravel washed.

[3] Partly estimated for years before 1901.

Table 9.—Gold production at placer mines

Year	Mechanical and hydraulic methods ¹			Small-scale hand methods			Total ²		
	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)
1964	3	9	80	4	2	24	7	11	104
1965	-------	-------	-------	5	3	31	5	3	31
1966	1	(³)	6	5	2	61	6	3	67
1967	-------	-------	-------	2	1	26	2	1	26
1968	-------	-------	-------	3	(³)	6	3	(³)	6

[1] Combined to avoid disclosing individual company confidential data.
[2] Data may not add to totals shown because of independent rounding.
[3] Less than ½ unit.

Table 10.—Mine production of gold, silver, copper, lead, and zinc in 1968, by counties, in terms of recoverable metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
Adams	1	--------	8	(¹)	800	$2
Blaine	7	--------	67	$3	204,502	439
Boise	3	--------	W	W	W	W
Bonner	4	--------	W	W	4,054	9
Camas	1	--------	2	(¹)	859	2
Clark	1	--------	----------	----------	321	1
Custer	9	--------	122	5	310,835	667
Idaho	1	1	2	(¹)	----------	----------
Jerome	1	1	3	(¹)	W	W
Lemhi	9	--------	W	W	2,696	6
Owyhee	--------	1	1	(¹)	----------	----------
Shoshone	21	--------	2,017	79	15,429,064	33,089
Undistributed ²	8	--------	1,005	39	5,584	12
Total ³	65	3	3,227	127	15,958,715	34,225

County	Copper		Lead		Zinc		Total value ³ (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Adams	33	$27	--------	--------	--------	--------	$29
Blaine	(¹)	(¹)	1,646	$435	704	$190	1,066
Boise	-------	--------	(¹)	(¹)	(¹)	(¹)	W
Bonner	W	W	11	3	3	1	W
Camas	-------	--------	1	(¹)	2	(¹)	3
Clark	(¹)	(¹)	24	6	1	(¹)	7
Custer	91	76	1,437	380	614	166	1,293
Idaho	-------	--------	--------	--------	--------	--------	(¹)
Jerome	-------	--------	W	W	--------	--------	W
Lemhi	W	W	17	4	2	(¹)	W
Owyhee	-------	--------	--------	--------	--------	--------	(¹)
Shoshone	2,797	2,341	51,468	13,600	55,914	15,097	64,206
Undistributed ²	604	505	187	49	8	2	632
Total ³	3,525	2,950	54,790	14,478	57,248	15,457	67,237

W Withheld to avoid disclosing company confidential data; included with "Undistributed."
[1] Less than ½ unit.
[2] Includes values and quantities that cannot be shown separately for Bannock, Butte, Cassia, Elmorc, Valley, and Washington Counties and items indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

Table 11.—Mine production of gold, silver, copper, lead, and zinc in 1968, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines	Material sold or treated (thousand short tons)	Gold (troy ounces)	Silver (thousand troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Ore:							
Dry gold	5	(1)	136	(1)	-------	-------	-------
Dry silver-gold	3	(1)	77	1	-------	(1)	(1)
Dry silver	16	480	793	11,864	[2] 4,641	3,487	1,776
Total [3]	24	480	1,006	11,865	4,641	3,488	1,776
Copper and zinc	12	77	800	60	1,276	2,407	6,652
Lead	18	161	711	1,880	259	26,421	3,013
Lead-zinc	13	667	702	1,888	628	66,796	89,072
Total [3]	43	905	2,213	3,828	2,163	95,624	98,737
Other lode material:							
Silver old tailings, copper precipitates, lead-zinc mill cleanings, lead-zinc old tailings and zinc old tailings [4]	5	267	2	229	100	7,480	2,376
Zinc slag	1	58	-------	37	146	2,988	11,607
Total [3]	6	325	2	266	246	10,468	13,983
Total [3]	[5] 65	1,710	3,221	15,959	7,050	109,580	114,496
Placer	3	(6)	6	-------	-------	-------	-------
Total all sources	68	1,710	3,227	15,959	7,050	109,580	114,496

[1] Less than ½ unit.
[2] Includes small amount of copper from gold and gold-silver ore.
[3] Data may not add to totals shown because of independent rounding.
[4] Combined to avoid disclosing individual company confidential data.
[5] Detail does not add to total because some mines produce more than one class of material.
[6] 75 cubic yards.

Table 12.—Mine production of gold, silver, copper, lead, and zinc in 1968 by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (thousand troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Amalgamation, concentration, and smelting of concentrates [1]	2,986	15,867	6,648	105,793	102,705
Direct smelting:					
Ore, mill cleanings, old tailings, and precipitates [1]	235	55	256	799	184
Old slag	-------	37	146	2,988	11,607
Total [2]	3,221	15,959	7,050	109,580	114,496
Placer	6	--------	--------	--------	---------
Grand total	3,227	15,959	7,050	109,580	114,496

[1] Combined to avoid disclosing individual company confidential data.
[2] Data may not add to totals shown because of independent rounding.

be magnetite from the Rock Island Gypsum Co.'s Iron Mountain mine. Porter Bros. Co., a division of Michigan Chemical Corp., also shipped magnetite from a stockpile at Lowman.

Lead.—The effects of the nationwide copper strike continued to reduce total lead output, resulting in an 11-percent reduction in lead production from that of the previous year. Coeur d'Alene region mines

Table 13.—Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, in terms of recoverable metals

Year	Mines (lode) producing	Material sold or treated [1] (thousand short tons)	Gold, lode and placer (troy ounces)	Silver, lode and placer (thousand troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value (thousands)
1964	18	1,482	2,952	16,122	3,336	69,586	58,054	$57,146
1965	21	1,592	2,713	17,918	3,540	63,474	56,443	62,054
1966	21	1,786	2,775	19,092	3,454	67,891	58,877	64,880
1967	26	1,595	2,444	16,483	2,714	57,587	54,807	59,008
1968	21	1,557	2,017	15,429	2,797	51,468	55,914	64,206
1884–1968	XX	[2] 117,526	451,559	754,344	124,981	7,010,451	2,554,907	2,277,724

XX Not applicable.

[1] Does not include gravel washed.

[2] Complete data not available 1884–1904.

—principally the Bunker Hill, Star-Morning Unit area, Lucky Friday, and Page—accounted for most of the State total.

Stable prices and firm demand following resumption of full-scale operations in the latter half of the year enabled mine operators to continue extensive exploration and development programs in the Coeur d'Alene region.

A major undertaking at the Bunker Hill mine was the replacement of all bottom-dump ore cars with 150 new side-dump cars at an estimated cost of $85,000. Six hundred feet of track were rerailed in the Kellogg tunnel. Construction began on the new $2.5 million updraft sintering facility to house a recently purchased Lurgi updraft sinter machine which was scheduled to arrive about August 1, 1969. A new conditioner tank was put in operation at the Bunker Hill concentrator.

The Atlas Mining Co. tunnel above Boulder Creek near Mullan was enlarged and extended into a new ore-bearing vein.

Total lead production of 46,631 tons from 828,301 tons of ore was reported from 18 lead mines, 13 lead-zinc mines, one lead-zinc tailings operation, and one lead-zinc cleaning operation. Significant developments included the following:

Mineral Hills District (Blaine County).—The Federal Resources Corp. Silver Star-Queens mine at Bellevue was the leading lead producer in Blaine County, recovering 1,510 tons of lead and 649 tons of zinc from 27,684 tons of ore. Smaller amounts of lead were also mined at its Eureka mine and at the Star mine of Dee Bee Mining Co.

Hunter District (Shoshone County).—The decrease in production to 189,936 tons of lead-zinc ore at the Star-Morning Unit area mines, owned 70 percent by The Bunker Hill Co. and 30 percent by Hecla Mining Co., was mainly attributed to the continuing efforts expended on the No. 4 shaft project. Approximately 400 feet of No. 4 shaft was sunk below the 7100 level, which enabled development work to start at the 7300 level, using an experimental 9-foot-diameter "Jarva" tunneling machine. Ore containing 8,509 tons of lead, 15,590 tons of zinc, 50 tons of copper, and 383,807 ounces of silver was recovered.

Hecla's Lucky Friday mine resumed production in June after settlement of the strike which began October 15, 1967. The limited development work carried on during the strike was reflected in a decrease of ore reserves from 677,000 tons at the beginning of the year to 626,000 tons at yearend, according to Hecla's annual report. Production also declined 34 percent from that of the previous year to 95,923 tons of ore averaging 15.7 ounces of silver per ton, 10 percent lead, and 0.9 percent zinc.

Hecla signed agreements during the year with Day Mines, Inc., Independence Lead Mines Co., and Abot Mining Co. for exploration of portions of their properties from the lower levels of the Lucky Friday mine. The work was to be undertaken after deepening the shaft an additional 200 feet and completing a station at the new 4050 level which was to be used for access to the projected work area.

Lelande District (Shoshone County).—The Canyon silver mine in Burke Canyon was developed on the 220 and 410 levels. Shipment of 2,323 tons of ore containing

197 tons of lead, 48 tons of zinc, and 13,381 ounces of silver was made to the Bunker Hill smelter.

Placer Center District (Shoshone County).—According to the annual report of Day Mines, Inc., production from the Dayrock mine totaled 26,142 tons, averaging 7.1 percent lead, 0.8 percent zinc, and 7.1 ounces of silver per ton, and ore reserves increased during the year to 104,780 tons. Development work on the 1450 level delineated new ore shoots on the Ohio and Hornet veins during the year. The development work reported was 1,092 feet of drifting, 145 feet of crosscutting, and 917 feet of raising.

Yreka District (Shoshone County).—The Bunker Hill Co. reported to its stockholders that lead production dropped slightly at the Bunker Hill mine, but that the lead smelter operated at capacity and produced 1.5 percent more lead than it did in 1967, the previous record year. The electric furnace at the lead smelter went back on line in September after the interior had been rebuilt.

Mercury.—El Paso Natural Gas Co. and Electronic Metals, Inc., were the only mercury producers in the State during the year. El Paso Natural Gas was the major producer, mining 64,073 tons of ore at its Idaho-Almaden mine near Weiser, from which 1,042 flasks of mercury were recovered.

Molybdenum.—Exploratory geological work and diamond drilling were conducted for molybdenum at a prospect in south-central Idaho. About a mile northeast of Castle Peak in the White Cloud Range, American Smelting and Refining Company (Asarco) drilled 10 exploratory holes.

Silver.—Exploration for silver deposits continued in the Coeur d'Alene region because of an increase in the price of silver that raised the yearly average to $2.14 per ounce. Asarco, Hecla Mining Co., Sunshine Mining Co., and The Bunker Hill Co. were active.

Asarco completed work on the 4,400-foot "Coeur Shaft" west of Wallace, including stations at the 3100 and 3400 levels, and expanded the exploratory project by pushing crosscuts south from the 3100 level on the newly completed shaft. Installation of equipment on the 3400 level was completed, and drilling was started on the Rainbow vein.

Asarco opened up a new ore body on the 2800 level of the Galena mine in the "Argentine" area. The silver ore vein was exposed about 500 feet from the west end line of the Galena mine which adjoins the "Coeur Project" on the east.

Several mineral properties in the Central Silver Belt of the Coeur d'Alene mining district were consolidated and leased to Asarco for exploration and development.

The Bunker Hill Co. explored mineralized veins at depth in the Princeton property east of Mullan. The Magna shaft was dewatered, a station excavated, and crosscutting begun toward the downward projections of three mineralized veins intercepted in the Magna tunnel. In addition, surface trenching, geological mapping, and soil sampling were also done.

Hecla Mining Co. made plans to explore for silver and other minerals underneath the town of Mullan from an extension of the Lucky Friday mine deep levels. Additional exploration from deep levels of the mine was planned for consolidated properties in a large area northwest of the Lucky Friday mine.

Sunshine Mining Co. outlined a new ore body by diamond drilling at the Mascot Silver-Lead Mines property on Pine Creek, south of Kellogg. Sunshine began drilling in the Pine Creek district from the lower Nabob Silver-Lead Co. tunnel, from the Nevada-Stewart Mining Co. property, and from the East Coeur d'Alene Silver Mines property, 4½ miles southeast of the Sunshine mine.

Silver Star-Queens Mine, Inc., explored properties near Bellevue by drilling. Hecla Mining Co. explored a portion of Nine Corp. ground in the Dobson Pass area north of Wallace. Duval Corp. rehabilitated the mining camp at Conjecture Mines, Inc., silver mine near Lakeview, returned the hoist to operation, dewatered the shaft to below the 700-foot level, and completed cleanup work on the 700 level preparatory to drifting. Exploratory crosscutting was conducted at Silver Butte Mining Co.'s property in Bonner County. Day Mines, Inc., drilled a series of deep holes in the Placer Creek district. Silver Dollar Mining Co. drilled near Burke on the property of Benton Mining Co.

A new publication describing silver and gold prospects in the Silver City region of

Owyhee County was published by the Idaho Bureau of Mines and Geology.[6]

Despite the impetus of increasing prices for silver, which resulted in an alltime monthly average high of $2.31 per ounce in July, silver production declined 6 percent from that of the previous year as a result of the continuing loss of byproduct silver from operations affected by the copper strike during the first 3 months of the year. However, the value of the silver produced during the year increased nearly 30 percent to $34,225,000.

Sunshine Mining Co. was the leading silver producer in the State with a yearly production of 7,867,822 ounces of silver from the Sunshine mine in the Coeur d'Alene mining region. Additional mines in the Coeur d'Alene region yielding substantial quantities of silver included the Bunker Hill, Crescent, Galena, Lucky Friday, Page, Star-Morning Unit, and Silver Summit. The Clayton mine in Custer County yielded 290,472 ounces of silver. Significant developments occurred in the following districts:

Evolution District.—The Sunshine mine production of silver was 0.18 percent higher than in 1967. Approximately 7,867,800 ounces of silver, 260 ounces of gold, 1,340 tons of copper, 320 tons of lead, and 288 tons of zinc were recovered from 252,090 tons of ore. A service hoist was installed at the No. 10 shaft during the year, the shaft was deepened to the 5600 level, and work began on the 5600 level station. Crosscuts from the No. 10 shaft were extended to the "Hook-Chester" vein on the 5000 and 5200 levels. Development of the vein on the 4800 level was completed, and the sinker hoist was moved to the 5200 level where shaft sinking resumed at yearend.

Sunshine Mining Co. developed the Sun Con property west of the Sunshine mine by advancing the 3700 west drift 400 feet along the Yankee Girl vein. A raise was begun on one of the ore shoots exposed on the 3700 level and driven 180 feet toward the 3400 level by yearend. Sunshine also explored the property of Bismarck Mining Co. by driving a development crosscut on the 2700 level.

Hecla Mining Co. reported that only a limited amount of development work was done during the year at the Silver Summit mine, because major efforts were directed to consolidation of the property with those of seven other companies adjoining the mine into the Consolidated Silver Corp. A total of 1,233 acres of mineral property was combined for exploration at depth through extensions of present openings in the Silver Summit mine. Production during the year dropped to 21,932 tons of ore from which 394,048 ounces of silver and 109 tons of copper were recovered.

Placer Center District.—Operations resumed in April at the Galena mine, and development work resulted in an increase in ore reserves, according to the Asarco annual report. Work continued on the planned $500,000 expansion project of the Galena mill in Lake Gulch, west of Wallace. The completed project will increase the Callahan Mining Corp.'s mill capacity from 500 to 750 tons daily. Work continued on deepening the No. 3 shaft below the 3700 level. Production during the last 8 months of 1968 was 92,660 tons milled ore, averaging 21.2 ounces of silver per ton and 0.8 percent copper, according to Day Mines, Inc., which has a 25-percent interest in the property.

Yreka District (Shoshone County).—A total of 3,161,471 ounces of silver valued at $6,780,091 was produced from eight mines in the Yreka district. The largest producers were the Crescent and Bunker Hill mines of The Bunker Hill Co., acquired during the year by Gulf Resources and Chemical Corp. of Houston, Tex.

The Bunker Hill Co. installed a 300 ton, coil-cooling system at the 3100 level of the Crescent mine which lowered the temperature about 20 degrees. The Rope raise in the No. 2 shaft project at the Crescent mine was completed, and most of the hanging wall was bolted. Work began on the No. 2 shaft which was to be a 600-foot production and service shaft extending from the 3100 to the 3700 levels, 1,500 feet northwest of the No. 1 (Ellis) shaft. The completed shaft was scheduled to replace the Alhambra winze which serviced operations on the 3300 and 3500 levels.

Bayhorse District (Custer County).—A 21-percent increase in production to 83,049 tons of silver ore at Clayton mine resulted in a new record high year for the Clayton Silver Mines. Approximately 290,472 ounces of silver, 38 tons of copper,

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[6] Asher, R. R. Geology and Mineral Resources of a Portion of the Silver City Region, Owyhee County, Idaho. Idaho Bur. Mines and Geol., Pamph. 188, June 1968, 106 pp.

1,362 tons of lead, and 552 tons of zinc were recovered from Clayton ore. Concentrates accumulated during the smelter strike were sold along with current production after April. The Clayton mill was operated 356 days of the year at its capacity rate of 230 tons per day. Beginning in early November, all silver in lead concentrates was sold subject to a deferred pricing arrangement with the smelter. At yearend, 36,123 ounces of silver had been sold subject to deferred pricing. Mining continued throughout the year from the 800 level North Stope.

Tungsten.—The Tungsten Jim mine of Salmon River Scheelite Corp. was the only reported tungsten producer in the State during the year. Total output declined, and shipments from two small operations in Valley County were discontinued.

Vanadium.—Output of vanadium declined 7 percent from that of 1967. Because of depressed market conditions, Vitro Chemical Co. placed its Salt Lake City, Utah, vanadium recovery plant on an indefinite standby basis, curtailing ferrophosphorus purchases from the FMC Corp. operation in Power County. Ferrophosphorus, produced at the Monsanto Co.'s elemental phosphorus plant at Soda Springs, continued to be processed for vanadium values at the nearby Kerr-McGee facility.

Zinc.—The Star-Morning Unit area, Bunker Hill, Page, and Lucky Friday mines in the Coeur d'Alene area continued to supply the major portion of the State's zinc production, accounting for 79 percent of the total. Total State production of 57,248 tons was over 1 percent higher than that of the previous year despite the industry-wide strike in the first 3 months.

The Bunker Hill Co. was the principal supplier of metallic zinc, derived from company-owned ore, custom ore, and small shipments from Canada. The planned expansion and modernization of the Bunker Hill zinc plant continued during the year, despite the effects of the copper strike. Work progressed on converting a cathode stripper to an automated system in the electrolytic cell room. A new rotary-type compressor replaced one of the reciprocating type, and a new storage and handling building was completed. A switch from batch leaching to continuous leaching was completed during the year, and a 350-ton-per-day flash roaster, started in the fall of 1967, was put into operation on April.

The Clayton mine continued operating and stockpiled concentrates produced while the smelters were closed by the copper strike. After settlement of the strike in April, Clayton Mining Co. resumed shipments, including some concentrates accumulated during the strike. Because of limited smelter purchases, Clayton reported 983 tons of concentrates valued at $67,014 still on hand at yearend.

Six zinc mines in the State reported production of 44,845 tons of ore containing 3,326 tons of zinc. Lessees continued to supply significant amounts of zinc from the Bunker Hill mine area in the Yreka mining district. A large portion was obtained from the Monitor and Mountain Goat mines in the Beaver mining district of Shoshone County. According to the annual report of Day Mines, Inc., 10,815 tons of ore containing 12.1 percent zinc was milled at the Monitor mine; the Mountain Goat lease, adjoining the Monitor mine, also yielded 8,585 tons of ore averaging 9.9 percent zinc. Development work totaled 873 feet of drifting and 872 feet of diamond drilling.

NONMETALS

Cement.—Portland and masonry cements were produced and shipped from the Inkom, Bannock County, operations of Idaho Portland Cement Co. Production and shipments of portland cement were 6 and 12 percent greater than respective totals for the previous year; masonry cement output remained substantially the same. Limestone for cement manufacture continued to be supplied from the adjacent company-operated Inkom quarry.

Clays.—The quantity of clays sold or used by producers declined 8 percent compared with the total of the previous year. A 35-percent drop in the output of miscellaneous clay for producing heavy-clay construction products was the principal reason for the decline; curtailed output of fire clay also contributed. Miscellaneous clay was mined from operations in Bingham, Bonneville, Cassia, Jefferson, and Minidoka Counties. Fire clay for refractories manufacture was mined for A. P. Green Refractories Co. from a pit near Helmer, Latah County. J. R. Simplot Co. continued mining and processing kaolin at operations in Latah County for use as a filler clay by the paper industry. Output was increased substantially compared with that of the previous year.

Garnet.—Production and shipments of abrasive garnet by Idaho producers increased 27 and 18 percent compared with respective totals for the previous year. Shipments, from operations of Idaho Garnet Abrasive Co. (a division of Sunshine Mining Co.) and Emerald Creek Garnet Milling Co., both near Fernwood, Benewah County, went mainly to west coast markets for use as an airblast abrasive.

Gem Stones.—The value of gem materials collected in the State was estimated at $200,000. Star garnet and faceting-grade garnet from diggings near Fernwood, Benewah County, continued as the principal gem material sought by the public. A discovery of gem-quality opal in the Bitterroot Mountains near Spencer, Clark County, was opened to the public for fee-digging during the year. Portions of the deposit were bulldozed into terraces to facilitate recovering the gem material by collectors. The deposit, which is at an elevation of 7,000 feet, was operated during the summer and early fall months. The charge for digging was $10 per individual per day. Collectors were allowed up to 5 pounds of opal material; additional material cost $2 per pound. Special rates reportedly were available for clubs and groups.[7]

Gypsum.—Rock Island Gypsum Co. mined a small quantity of gypsum from the firm's Rock Creek mine, northwest of Weiser, Washington County. Shipments, for agricultural use, were lower than those for 1967.

Lime.—Limestone was calcined to quicklime at sugar refineries in Bonneville, Canyon, Minidoka, and Twin Falls Counties. Production, all for use in sugar refining, remained substantially the same as for the previous year. Secondary lime production, regenerated from calcium-carbonate sludge, was continued at a kraft paper plant in Nez Perce County.

Peat.—Idaho Peat, Inc., continued producing and shipping reed-sedge peat from an operation near Downey, Bannock County. Shipments, mainly in bulk form for horticultural and general soil improvement uses, were significantly lower than those for the previous year.

Perlite.—Perlite mined at an open-pit operation north of Malad, Oneida County, by Oneida Perlite Corp. was crushed, sized, and shipped to the firm's storage and expanding plant at Malad City. Expanded perlite was shipped to markets in the Western States for use as loose-fill insulation, plaster, and concrete aggregate, and for soil conditioning.

Phosphate Rock.—Production of both crude and marketable phosphate rock increased sharply over totals for 1967. Mine production of phosphate rock increased 20 percent over the 3.3-million-ton total of the previous year; production of marketable phosphate rock by producers totaled 3.9 million tons. Phosphate rock was mined by three firms at four operations in two counties. J. R. Simplot Co. continued production from the Gay and Conda mines in Bingham and Caribou Counties, respectively. Monsanto Co. mined phosphate rock from the Ballard property, northwest of Soda Springs, Caribou County. Stauffer Chemical Co. obtained phosphate rock from the Wooley Valley deposit, northeast of Soda Springs, Caribou County. Output from the Stauffer operations was shipped to Silver Bow, Mont., for use in manufacturing elemental phosphorus.

The quantity of phosphate rock sold or used by producers remained substantially the same as that in the previous year. Because significant tonnages of phosphate rock were added to stocks during the last half of the year, the sold or used total did not reflect the gain registered for the marketable output. Reduced requirements for phosphate rock for fertilizer manufacture, including wet-process phosphoric acid, were largely offset by increased quantities going to export markets and to elemental phosphorus manufacture. Elemental phosphorus production continued as a major use of phosphate rock produced in the State.

Phosphate rock continued to be processed to elemental phosphorus at plants of FMC Corp., Mineral Products Division, Pocatello, and Monsanto Co., Soda Springs. FMC Corp. completed installation of additional ore unloading and handling equipment at the Pocatello plant.

J. R. Simplot Co. continued manufacturing phosphate fertilizer products at the firm's Pocatello fertilizer works. Phosphate rock from the company mines in Bingham and Caribou Counties supplied the raw materials.

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[7] Oles, Floyd, and Helga Oles. Precious Opal in the Bitterroot Mountains. Gems and Minerals, October 1968, 3 pp.

Mountain Fuel Supply Co. processed purchased phosphate rock at the firm's beneficiating and calcining facilities near Conda, Caribou County. Processed rock was marketed to fertilizer manufacturers in the Western States and Canada. In October, the firm announced a contract with Cominco, Ltd., of Trail, British Columbia, Canada, to supply washed and calcined phosphate rock to Cominco's fertilizer works at Warfield, British Columbia. The contract reportedly would enable Mountain Fuel to operate the facility on a 24-hour basis, 5 days per week.

The Bunker Hill Co. continued production of phosphate fertilizer products at Kellogg, Shoshone County. Calcined phosphate rock purchased from Wyoming sources and sulfuric acid produced from waste gases at the nearby company zinc smelter were used as raw materials for manufacturing the fertilizer products. In April, plans were announced for constructing a $2 million, 200-ton-per-day facility for manufacturing ammonium sulfate fertilizer at the Kellogg complex. Sulfuric acid produced by the firm at Kellogg would be a principal raw material used in manufacturing the fertilizer. The plant was to be owned and operated exclusively by Bunker Hill, in contrast to the existing phosphoric acid fertilizer facility, which was operated jointly with Stauffer Chemical Co. The plant was scheduled to begin production by April 1969.

Pozzolan.—El Paso Natural Gas Co. continued producing and shipping pozzolan from operations near Weiser, Washington County. Calcined opalite, a waste product of the firm's adjacent mercury furnace operation, was used as the raw material feed for the pozzolan plant. Five thousand tons was shipped, mainly for use as a concrete additive at dam construction projects, compared with 35,000 tons the previous year. Completion of a dam project was the reason for the sharp decline in output.

Pumice.—Pumiceous materials sold or used by producers registered a fourfold increase over the 1967 total, mainly due to greater use of volcanic cinder and scoria at State highway department projects. Output by commercial firms was increased 24 percent over that of the previous year. Pumice was produced in Bonneville and Oneida Counties; volcanic scoria was produced at one operation in Canyon County. Output for commercial markets was used mainly as lightweight aggregate in precast-concrete construction products; smaller quantities were used as roofing rock and for landscape and decorative purposes. In addition, large quantities of cinder and scoria were used at road projects of the State highway department in Gooding County.

Sand and Gravel.—Production of sand and gravel declined 27 percent from the 11.2-million-ton total in 1967. The sharp drop resulted from reduced requirements for these materials at State highway department projects (3.8 million tons in 1968 compared with 6.2 million tons in 1967). Government-and-contractor production (largely production by contractors for Federal, State, county, and municipal agencies) was 33 percent lower than that in the previous year. Output for commercial markets remained substantially the same. Plants producing over 100,000 tons accounted for 35 percent of the commercial sand and gravel total compared with 64 percent of the previous year's production. Production exceeded 1 million tons each in Jefferson and Bannock Counties, owing largely to State highway department projects underway in these counties. Production was reported from operations in 38 of the 44 counties in the State; however, significant quantities also were produced which could not be assigned to a specific county of origin.

Del Monte Properties Co. continued producing and shipping quality sands for plaster, glass, abrasives, and other specialty uses from operations near Emmett, Gem County.

Stone.—Production of stone for all purposes increased 11 percent over the 1967 total. Greater demand for basalt and granite at Federal projects of the U.S. Army Corps of Engineers, Bureau of Public Roads, and U.S. Forest Service accounted for a major portion of the increase, more than offsetting sharply reduced stone requirements for State highway department projects. Granite was quarried in the greatest tonnages, the major portion of which was used at Federal dam construction projects in Clearwater County. Significant quantities also were used for road base and riprap. Basalt output ranked second in

Table 14.—Sand and gravel sold or used by producers, by classes of operation and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	434	$668	788	$1,242
Road material	1,302	1,170	1,153	1,254
Fill	148	98	137	150
Other [1]	261	276	84	193
Total	2,145	2,212	2,162	2,839
Government-and-contractor operations:				
Building	34	44	4	7
Road material	7,965	8,637	5,517	5,931
Fill	1,006	526	288	170
Other [1]	96	71	253	186
Total	9,101	9,278	6,062	6,294
All operations:				
Building	468	712	792	1,249
Road material	9,267	9,807	6,670	7,185
Fill	1,154	624	425	320
Other [1]	357	347	337	379
Total	11,246	11,490	8,224	9,133

[1] Includes special sands, railroad ballast, and sand and gravel used for miscellaneous purposes.

tonnage, and production went mainly for use as road base material, bituminous and concrete aggregate, and for riprap. The quantity of limestone quarried increased moderately; output was utilized in cement manufacture and for sugar refining. Sandstone and quartzite production advanced 40 percent, owing mainly to increased requirements for quartzite used as a furnace flux at elemental phosphorus plants. Significant tonnages quarried for road construction uses also contributed to the gain. Stone was produced in 14 counties. Largest production, 1.2 million tons, was from operations in Clearwater County. Production of over 100,000 tons was reported from Bannock, Caribou, Payette, and Shoshone Counties. In addition, tonnages were produced which could not be assigned to specific counties of origin.

Table 15.—Principal producers

Commodity and company	Address	Type of activity	County
METALS			
Antimony:			
Sunshine Mining Co	Kellogg, Idaho 83837	Plant	Shoshone.
Gold:			
J. C. Allison	Hansen, Idaho 83334	Placer	Jerome.
Charles Andrus	Marsing, Idaho 83639	do	Owyhee.
A. W. Josue	Garden Valley, Idaho 83622	Mine	Boise.
Earl Rice	Elk City, Idaho 83525	Placer	Idaho.
Jett Ward	Salmon, Idaho 83467	Mine	Lemhi.
Iron ore:			
Rock Island Gypsum Co	Weiser, Idaho 83672	do	Washington.
Lead:			
American Smelting & Refining Co	Wallace, Idaho 83873	Mine and mill.	Shoshone.
Bell Mountain Mining Co	Howe, Idaho 83244	Mine	Butte.
The Bunker Hill Co	Kellogg, Idaho 83837	Mine, mill, smelter.	Shoshone.
Clayton Silver Mines	Clayton, Idaho 83227	Mine and mill.	Custer.
Federal Resources Corp	Mine—Hailey, Idaho 83333	Mine	Blaine.
Do	Mill—Bellevue, Idaho 83313	Mill	Do.
Hecla Mining Co	Wallace, Idaho 83873	Mine and mill.	Shoshone.
Sidney Mining Co	Kellogg, Idaho 83837	Mine	Do.

See footnote at end of table.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Mercury:			
Electronic Metals, Inc	Boise, Idaho 83707	Mine and plant.	Valley.
El Paso Natural Gas Co	Weiser, Idaho 83673	do	Washington.
Silver:			
American Smelting & Refining Co	Wallace, Idaho 83873	Mine and mill.	Shoshone.
The Bunker Hill Co	Kellogg, Idaho 83837	do	Do.
Hecla Mining Co	Wallace, Idaho 83873	do	Do.
Sunshine Mining Co	Kellogg, Idaho 83837	do	Do.
Tungsten:			
Salmon River Scheelite	Clayton, Idaho 83227	Mine and plant.	Custer.
Electronic Metals, Inc	Boise, Idaho 83707	do	Valley.
Vanadium:			
Kerr-McGee Corp.[1]	Soda Springs, Idaho 83276	Plant	Caribou.
Zinc:			
American Smelting & Refining Co	Wallace, Idaho 83873	Mine and mill.	Shoshone.
The Bunker Hill Co	Kellogg, Idaho 83837	Mine, mill, smelter.	Do.
Day Mines, Inc	Wallace, Idaho 83873	Mine and mill.	Do.
Hecla Mining Co	do	do	Do.
Kennedy & Zanetti	do	do	Do.
NONMETALS			
Cement:			
Idaho Portland Cement Co	Inkom, Idaho 83245	Plant and quarry.	Bannock.
Clays:			
Burley Brick & Sand Co	Burley, Idaho 83318	Pit and plant.	Cassia and Minidoka.
A. P. Green Refractories Co	Troy, Idaho 83871	do	Latah.
Idaho Falls Brick and Tile Co	Idaho Falls, Idaho 83401	do	Bingham, Bonneville, Jefferson.
J. R. Simplot Co	Bovill, Idaho 83401	do	Latah.
Garnet:			
Emerald Creek Garnet Milling Co	Kellogg, Idaho 83837	Mine and plant.	Benewah.
Idaho Garnet Abrasive Co	do	do	Do.
Peat:			
Idaho Peat, Inc	Downey, Idaho 83234	Bog	Bannock.
Perlite (crude and expanded):			
Oneida Perlite Corp	Malad City, Idaho 83252	Pit and plant.	Oneida.
Phosphate Rock:			
FMC Corp. Mineral Products Div	Pocatello, Idaho 83201	Plant	Power.
Monsanto Co	Soda Springs, Idaho 83276	Mine and plant.	Caribou.
Mountain Fuel Supply Co	do	do	Do.
J. R. Simplot Co	Pocatello, Idaho 83201	Mine	Bingham.
Do	Conda, Idaho 83230	Mine and plant.	Caribou.
Stauffer Chemical Co	Montpelier, Idaho 83254	Mine	Do.
Pumice:			
Hess Pumice Products	Malad City, Idaho 83252	Mine and plant.	Oneida.
Idaho Concrete Products, Inc	Idaho Falls, Idaho 83401	do	Bonneville.
Western Block, Inc	Nampa, Idaho 83651	do	Canyon.
Sand and Gravel:			
Bannock Paving Co	Pocatello, Idaho 83201	Pit and plant.	Bannock.
Carl Carbon, Inc	Spokane, Wash 99201	do	Clearwater.
DeAtley Corp	Lewiston, Idaho 83501	do	Nez Perce.
Hunziker Sand & Gravel Co., Inc	Pocatello, Idaho 83201	do	Bannock.
Idaho Concrete Pipe Co., Inc	Caldwell, Idaho 83605	do	Canyon.
Morrison Knudsen Co., Inc	Boise, Idaho 83707	do	Ada.
Quinn Robbins Co., Inc	do	do	Do.
Byron C. Rambo Crushing Co., Inc	Nampa, Idaho 83651	do	Canyon.
Ready to Pour Concrete Co	Twin Falls, Idaho 83301	do	Twin Falls.
Strang Sand & Gravel	Nampa, Idaho 83651	do	Canyon.
Twin Falls Construction Co	Twin Falls, Idaho 83301	do	Twin Falls.
Stone:			
Carl Carbon, Inc	Spokane, Wash 99201	Quarry and plant.	Various counties.
DeAtley Corp	Lewiston, Idaho 83501	do	Clearwater.
Dworshak Dam Constructors	Orofino, Idaho	Quarry	Do.
Idaho Portland Cement Co	Inkom, Idaho 83245	do	Bannock.
Monsanto Chemical Co	Soda Springs, Idaho 83276	do	Caribou.
Washington Construction Co	Missoula, Mont 59801	do	Clearwater.

[1] Processed ferrophosphorus from Idaho.

The Mineral Industry of Illinois

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Illinois Geological Survey, for collecting information on all minerals except fuels.

By Thomas O. Glover[1]

Illinois mineral production in 1968 was valued at $647.5 million, nearly 2 percent more than in 1967. Increases in value of production were recorded for portland and masonry cements, clays, lime, peat, sand and gravel, stone, and tripoli. Declines in value were recorded for coal, fluorspar, lead, natural gas, natural gas liquids, petroleum, and zinc. Mineral fuels accounted for 69 percent of the total production value, nonmetals 30 percent, and metals 1 percent.

In 1968, Illinois ranked first among the seven States producing fluorspar, furnishing 75 percent of the Nation's total. The State ranked second in the Nation in stone production, fourth in sand and gravel output, and fourth in coal output. Illinois also ranked high in the processing of mineral raw materials.

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[1] Mining engineer, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Illinois[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland..............thousand 376-pound barrels..	9,069	$30,186	9,372	$32,475
Masonry..............thousand 280-pound barrels..	591	1,851	602	2,097
Clays [2]......................thousand short tons..	1,881	3,799	2,327	4,813
Coal (bituminous)...............................do....	65,133	252,975	62,441	250,685
Fluorspar...............................short tons..	210,207	9,859	188,325	9,134
Lead (recoverable content of ores, etc.)...........do....	2,384	668	1,467	388
Natural gas.......................million cubic feet..	5,144	602	4,380	552
Peat...short tons..	49,716	697	61,520	867
Petroleum (crude)...........thousand 42-gallon barrels..	60,115	181,581	56,891	173,120
Sand and gravel..................thousand short tons..	38,801	44,175	45,609	52,948
Stone...do....	48,458	66,757	55,858	80,188
Zinc (recoverable content of ores, etc.).......short tons..	20,416	5,652	18,182	4,909
Value of items that cannot be disclosed: Fuller's earth, gem stones, lime, natural gas liquids, and tripoli..........	XX	37,999	XX	35,372
Total..	XX	636,801	XX	647,548
Total 1957–59 constant dollars..................	XX	646,158	XX	p 639,974

p Preliminary. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fuller's earth, included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Illinois, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Adams	$2,525	$3,056	Stone, lime, coal, sand and gravel, petroleum.
Alexander	272	276	Tripoli, sand and gravel, stone.
Bond	555	854	Sand and gravel, petroleum, clays.
Boone	583	W	Sand and gravel, stone.
Brown	106	50	Stone, petroleum, clays, sand and gravel.
Bureau	1,485	2,238	Sand and gravel.
Calhoun	49	W	Stone.
Carroll	218	399	Stone, sand and gravel.
Cass	4	---------	
Champaign	708	607	Sand and gravel, petroleum.
Christian	W	W	Coal, petroleum, stone.
Clark [2]	3,041	3,142	Petroleum, stone, sand and gravel.
Clay	W	W	Petroleum, stone.
Clinton	W	W	Petroleum, stone, sand and gravel.
Coles	W	W	Do.
Cook	36,100	42,365	Stone, lime, sand and gravel, clays, peat.
Crawford	W	W	Petroleum, sand and gravel.
Cumberland [2]	503	435	Sand and gravel, stone.
De Kalb	768	654	Do.
De Witt	W	W	Petroleum, sand and gravel.
Douglas	W	W	Coal, petroleum.
Du Page	W	W	Stone, sand and gravel.
Edgar	272	312	Petroleum.
Edwards	2,652	2,368	Do.
Effingham	W	2,086	Petroleum, sand and gravel.
Fayette	W	W	Petroleum, stone, sand and gravel, clays.
Ford	281	393	Sand and gravel.
Franklin	W	W	Coal, petroleum.
Fulton	28,064	28,960	Coal, sand and gravel.
Gallatin	4,627	W	Coal, petroleum, sand and gravel.
Greene	W	W	Stone, clays.
Grundy	4,735	5,405	Sand and gravel, coal, clays.
Hamilton	16,833	11,647	Petroleum.
Hancock [2]	653	721	Stone, petroleum, sand and gravel.
Hardin	16,489	15,018	Fluorspar, zinc, stone, lead, sand and gravel.
Henderson	448	462	Stone, sand and gravel.
Henry	W	W	Do.
Iroquois	17	8	Sand and gravel.
Jackson	2,508	W	Coal, stone, sand and gravel.
Jasper	4,366	4,048	Petroleum.
Jefferson	W	W	Coal, petroleum, stone.
Jersey	146	W	Stone.
Jo Daviess	2,295	2,144	Zinc, stone, lead, sand and gravel.
Johnson	W	W	Stone, sand and gravel.
Kane	3,463	5,152	Sand and gravel, stone, peat.
Kankakee	W	W	Stone, clays, sand and gravel.
Kendall	570	545	Stone, sand and gravel.
Knox	W	W	Coal, stone, clays, sand and gravel.
Lake	709	1,144	Sand and gravel, peat.
La Salle	30,567	31,774	Cement, sand and gravel, clays, stone.
Lawrence	20,711	18,572	Petroleum, sand and gravel.
Lee	W	W	Cement, stone, sand and gravel, clays.
Livingston	3,203	3,332	Stone, clays, sand and gravel.
Logan	675	736	Stone, sand and gravel, coal.
McDonough [2]	W	W	Stone, clays.
McHenry	4,047	6,092	Sand and gravel, stone.
McLean	W	956	Sand and gravel.
Macon	W	474	Sand and gravel, petroleum.
Macoupin	1,692	W	Coal, stone, petroleum.
Madison	2,209	2,411	Stone, petroleum, sand and gravel.
Marion	W	W	Petroleum, stone.
Marshall	325	425	Sand and gravel, clays.
Mason	17	W	Sand and gravel.
Massac	W	W	Cement, stone, sand and gravel.
Menard	W	W	Stone.
Mercer	282	321	Stone, coal, clays.
Monroe	W	W	Stone.
Montgomery	W	12,853	Coal, stone, petroleum.
Moultrie	37	W	Sand and gravel, petroleum.
Ogle	2,193	2,241	Sand and gravel, stone.
Peoria	9,482	10,614	Coal, sand and gravel, stone.
Perry	37,812	35,596	Coal, petroleum.
Piatt	-------	33	Sand and gravel.
Pike	718	881	Stone, sand and gravel.
Pope	W	2	Sand and gravel.
Pulaski	W	W	Clays, stone, sand and gravel.
Putnam	W	W	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Illinois, by counties[1]—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Randolph	$11,882	$12,197	Coal, stone, petroleum, sand and gravel.
Richland	5,763	6,359	Petroleum.
Rock Island	W	2,946	Stone, sand and gravel.
St. Clair	28,639	31,854	Coal, stone, sand and gravel, clays.
Saline	W	W	Coal, petroleum.
Sangamon	1,100	1,742	Sand and gravel, petroleum, clays.
Schuyler	W	W	Stone, sand and gravel.
Scott	244	316	Stone, clays, sand and gravel.
Shelby	280	390	Petroleum, sand and gravel, stone.
Stark	W	W	Coal, sand and gravel.
Stephenson	730	686	Stone, sand and gravel.
Tazewell	1,543	1,343	Sand and gravel, clays.
Union	W	W	Stone, sand and gravel.
Vermilion	4,832	6,235	Coal, stone, clays, sand and gravel.
Wabash	8,105	7,490	Petroleum, sand and gravel.
Warren	W	W	Stone.
Washington	2,367	2,796	Petroleum, stone, coal, sand and gravel.
Wayne	16,976	18,841	Petroleum.
White	18,987	22,175	Petroleum, sand and gravel.
Whiteside	1,115	1,470	Peat, stone, sand and gravel.
Will	9,710	10,553	Stone, sand and gravel, coal.
Williamson	24,861	20,770	Coal, petroleum.
Winnebago	2,394	2,813	Sand and gravel, stone.
Woodford	111	W	Sand and gravel.
Undistributed[3]	247,146	234,767	
Total[4]	636,801	647,543	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Data for natural gas and natural gas liquids are not available on a county basis; however, value for these commodities are included with "Undistributed." Morgan County is not listed because no production was reported.

[2] Value of petroleum production in Cumberland County included with Clark County, and McDonough County with Hancock County because actual source of production cannot be identified.

[3] Includes value for natural gas, natural gas liquids, some petroleum (1967) and sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Illinois business activity

	1967	1968	Change (percent)
Employment and labor force, annual average:[1]			
Total labor force ... thousands	r 4,890.0	4,961.9	+1.5
Agricultural employment ... do	r 144.0	138.0	−4.2
Nonagricultural employment [2] ... do	r 4,585.4	4,661.4	+1.7
Manufacturing ... do	r 1,892.6	1,883.9	−.6
Construction ... do	r 176.3	189.2	+7.3
Mining, quarrying, and petroleum production ... do	r 24.7	23.9	−3.2
Bituminous coal mining ... do	8.8	9.0	+2.3
Crude petroleum and natural gas ... do	7.8	7.3	−6.4
Other mining and quarrying ... do	r 8.2	7.6	−7.3
Stone, clay, and glass products ... do	r 39.0	39.5	+1.3
Primary metal industries ... do	r 110.8	109.1	−1.5
All other ... do	2,991.8	3,064.4	+2.4
Payrolls, manufacturing [3] ... millions	$10,072.6	$10,674.0	+6.0
Personal income:			
Total ... do	$40,850	p $43,898	+7.5
Per capita	$3,752	p $3,994	+6.4
Construction activity:			
Building permits:[4]			
Valuation of authorized residential and nonresidential private construction ... millions	$944.8	$1,208.8	+27.9
Number of private and public residential building permits issued	65,495	79,920	+22.0
Contract construction work performed:			
Total ... millions	r $3,346	$3,168	−5.3
Nonresidential building ... do	$1,317	$1,197	−9.1
Residential building ... do	r $1,220	$1,482	+21.5
Nonbuilding ... do	$810	$489	−39.6
State highway division:			
Contracts awarded ... do	$294.7	$215.7	−26.8
Construction contract expenditures ... do	$170.0	$254.3	+49.6
Portland cement shipments to and within Illinois thousand 376-pound barrels	19,060	20,885	+9.6
Retail sales ... millions	$19,860	$21,127	+6.4
Farm marketing receipts ... do	r $2,572	p $2,591	+.7
Mineral production ... do	$636.8	$647.5	+1.7
Raw steel production ... thousand tons	10,649	10,510	−1.3
Utility production and consumption:			
Production of electric energy by electric utilities million kilowatt hours	63,675	p 68,021	+6.8
Natural gas consumption ... million cubic feet	962,078	1,008,061	+4.8

p Preliminary. r Revised.

[1] Adjusted to March 1968 benchmark levels.

[2] Includes nonagricultural wage and salary, self-employed, unpaid family workers, and domestic workers in private households.

[3] Includes workers covered under the Illinois Employment Security Act.

[4] Based on a nationwide universe of 13,000 permit issuing places.

Sources: Illinois Department of Labor in cooperation with the U.S. Department of Labor, Survey of Current Business, Construction Reports, Statistical Abstract of the United States, Illinois Department of Public Works and Buildings, Sales Management, Farm Income Situation, and the Federal Power Commission.

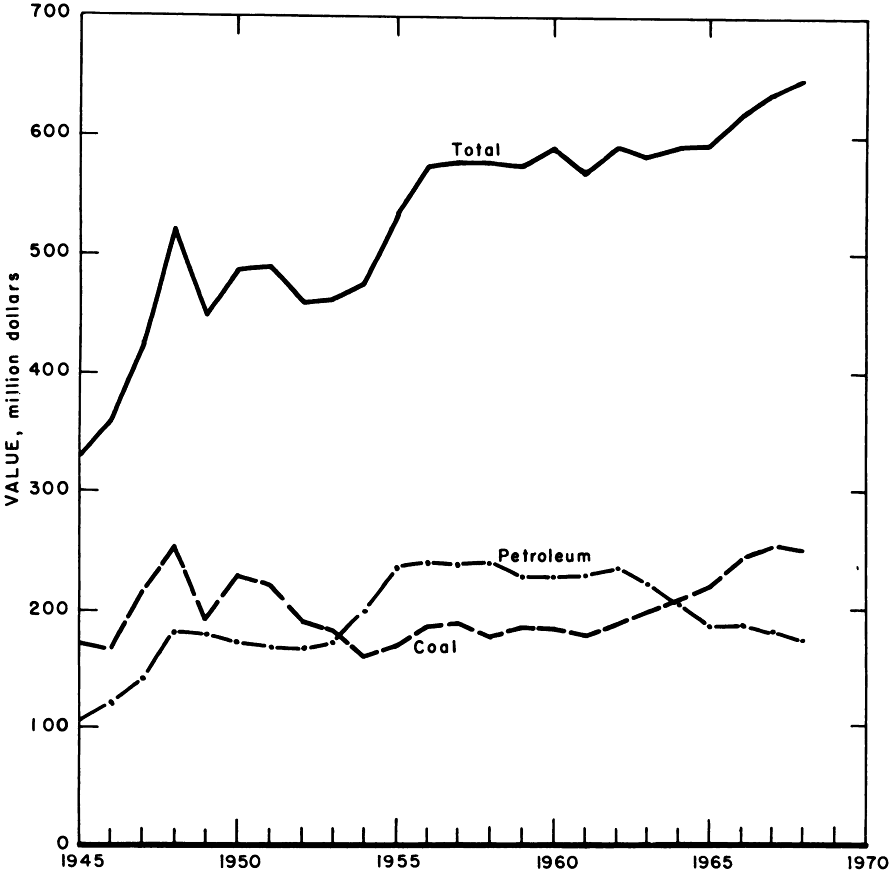

Figure 1.—Value of coal, petroleum, and total value of mineral production in Illinois.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Nonfatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1967:								
Coal	8,049	269	2,167	16,886	19	743	45.13	8,883
Peat	23	217	5	46	-------	2	43.50	174
Metal	52	252	13	105	-------	4	38.23	210
Nonmetal	1,245	261	325	2,652	-------	113	42.60	707
Sand and gravel	1,514	233	353	3,047	4	51	18.05	11,954
Stone	3,695	269	995	8,245	-------	135	16.37	638
Total [1]	14,578	265	3,857	30,981	23	1,048	34.57	6,249
1968:[p]								
Coal	7,900	266	2,092	16,200	15	750	47.16	7,775
Peat	25	208	5	48	-------	-------	-------	-------
Metal	50	271	13	104	-------	8	76.90	1,365
Nonmetal	1,140	280	323	2,624	2	80	31.25	5,683
Sand and gravel	2,190	231	507	4,221	1	74	17.77	2,006
Stone	3,665	268	984	8,167	1	130	16.04	1,405
Total [1]	14,940	262	3,923	31,362	19	1,042	33.80	5,182

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Illinois ranked fourth in the Nation in bituminous coal production with an output of 62.4 million tons valued at $250.7 million, representing decreases of 4 percent in quantity and 1 percent in value from the 1967 figures. The value of bituminous coal production comprised 39 percent of the total value of State mineral production.

About 57 percent of the coal produced was for consumption within the State. About 41 percent was shipped to consumers in Missouri, Wisconsin, Indiana, Iowa, Minnesota, and Kentucky. Electric utilities consumed over 71 percent of the output, general manufacturing and processing industries nearly 22 percent, retail dealers nearly 3 percent, and coke and gas plants nearly 4 percent. Sales to electric utilities decreased about 350,000 tons from that of 1967, and sales to general manufacturing and processing declined nearly 500,000 tons. Shipments to coke and gas plants increased by more than 200,000 tons. Shipments to all other consumers declined nearly 1.7 million tons.

About 80 percent of the coal was shipped by rail, about 9 percent by truck, 6 percent by water, and 5 percent by other means, including that transported from the mine to point of use by conveyor or tram. Over one-fourth of the rail shipments were by unit trains.

Total shipments of coal for consumption in Illinois were 43.5 million tons, of which 35.7 million tons came from within the State. Total shipments were down nearly 7 percent, and that portion supplied by Illinois coal mines decreased over 7 percent. Much of the decrease in shipments was due to strikes in the final quarter of the year.

Production was reported from 70 mines in 24 counties, excluding mines with less than 1,000 tons of annual production. Over 94 percent of the total output came from 13 counties with production in excess of 1 million tons each. Those counties, in order of rank, were Perry, St. Clair, Franklin, Fulton, Christian, Williamson, Saline, Jefferson, Montgomery, Randolph, Knox, Peoria, and Gallatin.

Thirty-six strip mines accounted for 58 percent of the total State production; 33 underground mines and one auger mine

Table 5.—Coal (bituminous) production in 1968, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines operated		Production (thousand short tons)			Value (thousands)
	Underground	Strip	Underground	Strip	Total [1]	
Adams	--------	1	--------	18	18	$98
Christian	1	--------	5,337	--------	5,337	W
Douglas	1	--------	654	--------	654	W
Franklin	5	--------	7,075	--------	7,075	W
Fulton	--------	6	--------	6,786	6,786	28,800
Gallatin	1	1	628	408	1,085	W
Grundy	--------	1	--------	368	368	W
Jackson	--------	4	--------	268	268	755
Jefferson	3	--------	3,184	--------	3,184	W
Knox	--------	2	--------	2,269	2,269	W
Logan	1	--------	28	--------	28	W
Macoupin	1	--------	291	--------	291	W
Mercer	1	--------	14	--------	14	W
Montgomery	2	--------	3,099	--------	3,099	W
Peoria	--------	4	--------	1,723	1,723	W
Perry	--------	4	--------	10,411	10,411	W
Randolph	1	1	918	1,740	2,658	W
St. Clair	2	2	637	6,475	7,112	W
Saline	3	3	1,818	1,422	3,240	W
Stark	--------	1	--------	561	561	W
Vermilion	2	[2] 2	50	[3] 795	845	4,210
Washington	1	--------	28	--------	28	W
Will	--------	1	--------	594	594	W
Williamson	8	4	2,642	2,216	4,857	20,884
Total [1]	33	[2] 37	26,392	[3] 36,049	62,441	250,685

W Withheld to avoid disclosing individual company confidential data; included in total.

[1] Data may not add to totals shown because of independent rounding.

[2] Includes one auger mine.

[3] Includes about 10,000 tons of auger-mine production.

Table 6.—Shipments of bituminous coal for consumption in Illinois, by district of origin and consumer use

(Thousand short tons)

Year and use	District of origin[1]						Total
	3 and 6	4	7 and 8	9	10	11	
1964:							
Electric utilities	--------	--------	35	2,852	19,706	402	22,995
Coke and gas plants	--------	--------	2,387	--------	922	--------	3,309
Retail dealers	45	4	1,295	1,093	2,203	169	4,809
All others	41	2	588	424	8,565	733	10,353
Total	86	6	4,305	4,369	31,396	1,304	41,466
1965:							
Electric utilities	--------	--------	--------	2,670	22,115	395	25,180
Coke and gas plants	19	--------	2,419	--------	1,170	--------	3,608
Retail dealers	34	15	1,305	1,116	1,959	129	4,558
All others	101	--------	695	420	8,903	891	11,010
Total	154	15	4,419	4,206	34,147	1,415	44,356
1966:							
Electric utilities	--------	--------	--------	2,198	25,058	552	27,808
Coke and gas plants	--------	--------	2,113	--------	1,513	--------	3,626
Retail dealers	8	13	1,364	930	1,889	59	4,263
All others	55	--------	740	256	9,113	521	10,685
Total	63	13	4,217	3,384	37,573	1,132	46,382
1967:							
Electric utilities	--------	--------	17	2,121	26,825	534	29,497
Coke and gas plants	110	--------	1,871	--------	1,468	--------	3,449
Retail dealers	5	12	1,342	847	1,831	37	4,074
All others	52	--------	553	182	8,386	517	9,690
Total	167	12	3,783	3,150	38,510	1,088	46,710
1968:							
Electric utilities	12	127	12	1,885	25,539	646	28,221
Coke and gas plants	196	--------	1,673	--------	1,200	--------	3,069
Retail dealers	--------	11	1,231	665	1,362	43	3,312
All others	41	--------	484	258	7,618	462	8,863
Total	249	138	3,400	2,808	35,719	1,151	43,465

[1] States or portion of States represented by each district are as follows: District 3 and 6—Northern West Virginia; 4—Ohio; 7 and 8—Eastern Kentucky, Southwestern Virginia, Southern West Virginia, and North-central Tennessee; 9—Western Kentucky; 10—Illinois; 11—Indiana.

contributed the remainder. Production from strip mines decreased 3 percent from that of 1967 and that from underground mines decreased nearly 6 percent. The average mine value was $4.01 per ton, up from $3.88 in 1967.

All but a minor fraction of the coal produced underground was loaded by machines, including 77 mobile loaders and 76 continuous miners. Equipment used in strip mines included 117 power shovels, draglines, and wheel excavators; 138 bulldozers; and 44 power drills. About 86 percent of the total production was cleaned by the 48 cleaning plants that operated during the year.

Nine companies and their subsidiaries each produced over 1 million tons in 1968, and together accounted for over 97 percent of the State production. Those companies were Ayrshire Collieries Corp.; Bell & Zoller Coal Co.; Freeman Coal Mining Corp.; Old Ben Coal Corp.; Peabody Coal Co.; Sahara Coal Co., Inc.; Southwestern Illinois Coal Corp.; Truax-Traer Coal Co. (Division Consolidation Coal Co., Inc.); and The United Electric Coal Cos. The River King strip mine in St. Clair County, owned by Peabody Coal Co., ranked first in the Nation in production. The Captain strip mine, in Perry County, owned by the Southwestern Illinois Coal Corp., ranked second in the Nation in production. The No. 10 underground mine in Christian County, owned by Peabody Coal Co., ranked fourth in production, but was the second largest underground mine.

Four new mines, two underground and

two strip, were opened. The underground mines were Orient No. 6, owned by Freeman Coal Mining Corp., in Jefferson County, and Old Ben No. 26, owned by Old Ben Coal Corp., in Franklin County. The strip mines were Houston Coal Co.'s No. 2 mine in Saline County, and the Elm mine, owned by Peabody Coal Co., in Peoria County.

Eleven mines, five strip and six underground, were abandoned. The strip mines were owned by Ajax Coal Co., Liberty Coal Co., Katler Mining Co. (two), and Peabody Coal Co. The underground mines were owned by Blue Bird Coal Co., El-B Coal Co., Inc., Florida Coal Co., Old Ben Coal Corp., Peabody Coal Co., and West Star Coal Co. Old Ben Coal Corp.'s No. 9 mine operated for 56 years and produced over 42.5 million tons.

The Old Ben Coal Corp. was acquired by The Standard Oil Co. (Ohio) in 1968.

Coke.—Almost 2.1 million tons of coke was produced in 1968, a decrease of about 12 percent from that of 1967. There were five plants in existence at yearend. Nearly all the coke consumed in Illinois was by the producing companies. About 96 percent of the coke produced was used in blast furnaces. About 3.1 million tons of coal was carbonized at Illinois coke plants, of which 37 percent came from Illinois; 61 percent from Kentucky and West Virginia; and the remainder from Pennsylvania and Virginia.

Producing plants recovered about 157,000 tons of coke breeze, representing an 11-percent decrease in recovery from 1967. Other products of coke-oven plants included coke-oven gas, tar, ammonia, crude light oil, and light-oil derivatives.

Peat.—Peat was produced by six companies in Cook, Kane, Lake, and Whiteside Counties. Sales increased 24 percent in quantity and value. Humus was sold in bulk form only, while moss and reed-sedge peat were sold in bulk and packaged form. About 88 percent of all sales were in packaged form. Nearly all the peat was used for general soil improvement; a small amount was used as an ingredient for potting soils.

Petroleum, Natural Gas, and Natural Gas Liquids.—Crude petroleum production declined 6 percent in quantity and 5 percent in value. The value of crude petroleum provided nearly 27 percent of the total State mineral output value. Waterflood oil production accounted for 75 percent of the total petroleum output.

The Illinois State Geological Survey reported the completion of 1,000 wells in 1968; 519 were producing oil wells, one was a gas well, 293 were dry holes in pools, and 187 were unsuccessful wildcats. Total footage drilled was 2,337,391, of which nearly 54 percent was in producing wells. Data do not include service wells, structure tests, and natural gas storage wells.

According to the American Petroleum Institute (API), proved crude oil reserves on December 31 were 314 million barrels, a 21-million barrel decrease from 1967. Proved reserves of natural gas on December 31 were 298 billion cubic feet, according to the American Gas Association (AGA), an increase of 39 billion cubic feet from 1967 estimates. Proved recoverable reserves of natural gas liquids totaled nearly 1.9 million barrels on December 31, according to the AGA.

NONMETALS

Cement.—Portland and masonry cements were produced by four companies with plants in La Salle, Lee, and Massac Counties. Portland cement shipments increased 3 percent in quantity and 8 percent in value. Shipments of masonry cement increased 2 percent in quantity but over 13 percent in value.

Nearly 97 percent of the portland cement shipments consisted of types I and II (general use and moderate heat). The remainder was high-early-strength and special-use types. Over 95 percent of the portland cement was shipped in bulk, the remainder in bags. Nearly 72 percent of the shipments were made by truck; the remainder by rail and water. About 78 percent of the portland cement shipments were to ready-mixed concrete companies, 8 percent to highway contractors, 7 percent to concrete product manufacturers, 5 percent to dealers in building materials, and the remainder to other contractors and various governmental agencies.

Over 66 percent of the portland cement shipments were to consumers in Illinois, 9 percent to Wisconsin, and 23 percent to Indiana, Iowa, Kentucky, Minnesota, Missouri, and Tennessee, combined. Of the masonry cement shipped, 33 percent went

Table 7.—Crude petroleum production, by counties

(Thousand 42-gallon barrels and thousand dollars)

County	1967		1968	
	Quantity [1]	Value [2]	Quantity [1]	Value [2]
Adams	2	$5	4	$12
Bond	108	327	82	251
Brown	3	9	4	12
Champaign	2	6	1	2
Christian	532	1,606	446	1,370
Clark [3]	700	2,114	611	1,877
Clay	3,045	9,197	2,866	8,799
Clinton	923	2,787	932	2,862
Coles	556	1,678	583	1,790
Crawford	3,164	9,557	2,599	7,979
Cumberland	(3)	(3)	(3)	(3)
De Witt	240	726	236	724
Douglas	92	279	65	199
Edgar	90	272	102	312
Edwards	878	2,652	771	2,368
Effingham	598	1,805	676	2,075
Fayette	7,512	22,692	6,732	20,667
Franklin	1,650	4,984	1,560	4,790
Gallatin	973	2,938	1,178	3,617
Hamilton	5,573	16,833	3,794	11,647
Hancock [3]	39	117	38	115
Jasper	1,446	4,366	1,319	4,048
Jefferson	1,607	4,854	1,442	4,425
Lawrence	6,774	20,462	5,952	18,272
McDonough	(3)	(3)	(3)	(3)
Macon	11	34	13	40
Macoupin	3	10	6	17
Madison	216	652	180	553
Marion	4,847	14,640	4,231	12,989
Montgomery	1	3	1	3
Moultrie	7	20	3	11
Perry	27	82	19	60
Randolph	109	328	121	372
Richland	1,908	5,763	2,071	6,359
Saline	1,105	3,338	1,083	3,324
Sangamon	115	346	225	691
Shelby	52	158	48	147
Wabash	2,633	7,953	2,381	7,311
Washington	532	1,606	615	1,889
Wayne	5,620	16,976	6,137	18,841
White	6,224	18,799	7,138	21,913
Williamson	43	129	126	386
Unassigned production	159	480	---------	---------
Total [4]	60,115	181,581	56,891	173,120

[1] Source: Illinois Geological Survey.
[2] County values calculated by using State average value per barrel; $3.02 for 1967 and $3.07 for 1968.
[3] Production of Cumberland County included with Clark County, and McDonough County with Hancock County because actual source of production cannot be identified.
[4] Data may not add to totals shown because of independent rounding.

Table 8.—Finished portland cement produced and shipped

(Thousand barrels and thousand dollars)

Year	Active plants	Production	Shipped from mills	
			Quantity	Value
1964	4	9,978	9,790	$32,191
1965	4	9,235	9,358	30,622
1966	4	9,108	9,208	28,617
1967	4	9,608	9,069	30,186
1968	4	9,719	9,372	32,475

to consumers in Illinois, 30 percent to Wisconsin, and over 28 percent to Tennessee. Approximately 14.7 million barrels of portland cement were shipped into Illinois from plants outside the State, mostly from Indiana, Michigan, and Missouri. In addition, 597,000 barrels of masonry cement were imported from out-of-State plants, principally from Indiana.

Almost 2.7 million tons of limestone and 392,000 tons of other raw materials, including clay and shale, gypsum, iron ore, sand, slag, air-entraining compounds, and grinding aids were used in manufacturing portland cement. About 263.8 million kilowatt-hours of electricity was used in the manufacturing process; nearly 65 percent was purchased, while the remainder was home-generated.

Clays.—Total production of fire clay and miscellaneous clay and shale increased 24 percent in quantity and 27 percent in value. Principal reason for the gain was a substantial increase in output for manufacturing lightweight aggregate. An increase in output of fire clay for refractory use was recorded, and production of fuller's earth for absorbent uses also increased markedly. Decreases occurred in production of material for manufacturing cement and heavy clay products.

Production of clay and shale was reported from 21 counties. Fire clay was produced by nine companies in Grundy, La Salle, McDonough, Marshall, and Scott Counties.

Fluorspar.—Illinois continued to rank first among the fluorspar-producing States, supplying 75 percent of the total domestic fluorspar output. Total Illinois shipments decreased 10 percent in quantity and 7 percent in value. Acid-grade fluorspar accounted for 46 percent of the sales; ceramic grade, 53 percent; and metallurgical grade, 1 percent. Sales of acid grade decreased almost 28 percent, but those for ceramic grade increased over 15 percent. Sales of metallurgical-grade fluorspar decreased almost 58 percent.

About 629,000 tons of crude ore was milled to produce 174,000 tons of finished fluorspar as well as byproduct lead and zinc concentrates. Crude ore came from Hardin and Pope Counties in Illinois and from Kentucky. A small amount of Illinois crude ore was processed in Kentucky. Crude ore was mined by Hastie Mining Co., Minerva Oil Co., and Ozark-Mahoning Co. The Aluminum Company of America and several small producers removed crude ore from stockpiles. The Rosiclare Works of Aluminum Company of America ceased operations in March after their stockpile of crude ore was depleted. Mining operations had ceased in 1965. The Minerva Oil Co. ceased operations at its Crystal mill in December, due to an ore shortage at the Crystal group of mines. The company also bottomed at 534 feet the Gaskins shaft in Pope County, 8 miles northwest of Rosiclare. The ore will be trucked 28 miles to its mill at Cave-in-Rock.

Lime.—Quicklime and hydrated lime were produced at six plants in Adams and Cook Counties. Total production increased about 4 percent. The major reason for increased output was greater usage in the metallurgical industry. Over 63 percent was used for chemical and industrial purposes, 31 percent for refractory purposes, and the remainder in construction. Of that portion used for chemical and industrial purposes, 81 percent was used in metallurgical processes and 12 percent in water purification. About 32 percent of the lime was shipped to consumers in Illinois, while 56 percent went to Indiana. Over 789,000 tons of lime was shipped into and within the State.

Perlite.—Crude perlite mined outside the State was expanded by seven companies with plants in Champaign, Cook, De Kalb, Kankakee, Lake, and Will Counties. Production of the expanded product increased nearly 11 percent in quantity and 10 percent in value. Principal uses included roof insulation, almost 73 percent; loose fill insulation, 4 percent; filter aid, 5 percent; building plaster, 3 percent; and other uses 15 percent. Johns-Manville Perlite Corp.'s minerals processing facilities at Joliet, which had no perlite production in 1968, were purchased by Pickands Mather & Co. in June. The plant will be used for the further processing of chemical products and various other mineral raw materials. The site also provides access for bulk shipments both to Great Lakes and gulf coast ports.

Sand and Gravel.—Illinois ranked fourth in the Nation in both quantity and value of sand and gravel produced. Total production increased 18 percent in quantity and 20 percent in value. Principal reasons for the gain were a 2.4-million-ton increase in output for paving and a 3.8-million-ton increase for building purposes. Production of industrial sands for abrasives, blast, chemical, enamel, engine, filler, filtration, foundry, glass, grinding and polishing, molding, oil (hydrafrac), pottery, porcelain, tile, and other purposes, increased almost 1 million tons. Production was reported from 75 counties in which there were 262 commercial and 103 Government-and-contractor operations. Over 81 percent of the commercial sand and gravel output was shipped by truck, and the remainder by rail or water.

Of the total sand and gravel produced, over 42 percent was used as paving material, 38 percent as building material, and the remainder as industrial sands, railroad ballast, and fill. Most use categories showed increases from 1967 in both quantity and value. The average value of the total sand and gravel was $1.16 per ton. Twelve counties (Bureau, Cook, Grundy, Kane, Lake, La Salle, McHenry, Peoria, Rock Island, Tazewell, Will, and Winnebago) had an output of over 1 million tons each. Combined, these counties accounted for 72 percent of the State total production.

Stone.—Illinois ranked second in the Nation in stone production and value. Nearly all production was limestone and dolomite, with only a small amount of sandstone (ganister) being mined in Alexander County. Total production increased over 15 percent in quantity and 20 percent in value. Over 79 percent of the production was used in concrete aggregate and roadstone; other major uses were for agricultural purposes and cement. The use of limestone for agricultural purposes increased nearly 24 percent, use in concrete aggregate and roadstone (increased by over 6 million tons) 17 percent, while the use in cement decreased less than 1 percent. Beginning with 1968, a more detailed

Table 9.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	6,575	$6,139	8,191	$7,993
Paving	6,874	5,464	7,130	6,288
Glass (unground sand only)	1,999	4,313	2,059	4,618
Molding (unground sand only)	1,036	3,571	1,038	3,749
Other [1]	3,417	6,625	4,088	7,078
Total	19,401	26,112	22,506	29,726
Gravel:				
Building	6,936	6,519	9,113	9,022
Paving	9,500	9,707	10,993	12,256
Railroad ballast	250	252	152	157
Fill	1,260	713	1,357	934
Other	--------	--------	11	11
Total	17,946	17,191	21,626	22,380
Total sand and gravel	37,347	43,303	44,132	52,106
Government-and-contractor operations:				
Sand:				
Paving	248	144	448	249
Fill	484	262	343	163
Total	732	406	791	412
Gravel:				
Building	--------	--------	11	6
Paving	722	466	674	418
Fill	--------	--------	1	1
Total	722	466	686	425
Total sand and gravel	1,454	872	1,477	[2] 835
All operations:				
Sand	20,133	26,518	23,297	30,138
Gravel	18,668	17,657	22,312	22,805
Total	38,801	44,175	45,609	52,943

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[1] Includes abrasives, blast, chemical, enamel, engine, fill, filler, filtration, foundry, glass (ground), grinding and polishing, oil (hydrafrac), pottery, porcelain, tile, railroad ballast, and other construction and industrial uses.

[2] Data may not add to total shown because of independent rounding.

Table 10.—Production of sand and gravel and stone in 1968, by counties[1]

(Thousand short tons and thousand dollars)

County	Sand and gravel		Stone	
	Quantity	Value	Quantity	Value
Adams	W	W	928	W
Alexander	109	W	1	$3
Bond	440	$510	------	------
Boone	W	W	W	W
Brown	4	W	W	W
Bureau	3,430	2,288	------	------
Calhoun	------	------	W	W
Carroll	13	W	319	W
Champaign	697	605	------	------
Christian	------	------	W	W
Clark	346	W	W	W
Clay	------	------	W	W
Clinton	6	3	W	W
Coles	183	184	W	W
Cook	1,294	1,358	W	W
Crawford	W	W	------	------
Cumberland	262	W	W	W
De Kalb	357	W	W	W
De Witt	W	W	------	------
Du Page	W	W	W	W
Effingham	15	11	------	------
Fayette	55	46	W	W
Ford	361	393	------	------
Fulton	529	660	------	------
Gallatin	W	W	------	------
Greene	------	------	290	483
Grundy	W	W	------	------
Hancock	1	1	412	605
Hardin	9	6	2,065	2,403
Henderson	7	4	303	458
Henry	57	W	W	W
Iroquois	13	8	------	------
Jackson	51	44	W	W
Jefferson	------	------	73	164
Jersey	------	------	W	W
Jo Daviess	48	39	276	283
Johnson	4	3	W	W
Kane	4,347	4,125	615	1,026
Kankakee	16	16	W	W
Kendall	280	W	W	W
Knox	44	22	W	W
Lake	1,410	W	------	------
La Salle	4,461	12,986	1,648	1,489
Lawrence	359	300	------	------
Lee	218	217	1,384	1,436
Livingston	W	W	1,888	3,019
Logan	289	W	W	W
McDonough	------	------	W	W
McHenry	6,862	$6,085	6	$7
McLean	879	956	------	------
Macon	450	434	------	------
Macoupin	------	------	W	286
Madison	W	W	W	W
Marion	------	------	W	W
Marshall	337	W	------	------
Mason	15	W	------	------
Massac	96	77	W	W
Menard	------	------	W	W
Mercer	------	------	W	W
Monroe	------	------	W	W
Montgomery	------	------	893	W
Moultrie	21	W	------	------
Ogle	710	1,579	544	662
Peoria	1,566	W	665	1,032
Piatt	56	33	------	------
Pike	W	W	522	W
Pope	4	2	------	------
Pulaski	53	31	W	W
Putnam	W	W	------	------
Randolph	W	W	1,198	1,479
Rock Island	W	W	W	W
St. Clair	W	W	2,907	4,686
Sangamon	848	W	------	------
Schuyler	W	W	W	W
Scott	5	8	136	W
Shelby	143	W	W	W
Stark	W	W	------	------
Stephenson	98	126	486	560
Tazewell	1,006	W	------	------
Union	17	14	836	W
Vermilion	172	W	W	W
Wabash	193	179	------	------
Warren	------	------	W	W
Washington	1	(2)	W	W
White	239	262	------	------
Whiteside	W	W	W	W
Will	3,335	W	2,846	3,720
Winnebago	1,748	1,685	852	1,128
Woodford	179	W	------	------
Undistributed[3]	6,861	17,703	33,765	55,311
Total[4]	45,609	52,943	55,858	80,188

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] All stone production consisted of limestone and dolomite, except Alexander County in which stone production consisted entirely of sandstone. No sand and gravel or stone production reported from the following counties: Cass, Douglas, Edgar, Edwards, Franklin, Hamilton, Jasper, Morgan, Perry, Richland, Saline, Wayne, and Williamson.

[2] Less than ½ unit.

[3] Includes production for which no county breakdown is available, and data indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

breakdown of aggregate and roadstone is presented in table 11. More than 88 percent of the crushed and broken stone was shipped by truck, 8 percent by rail, and the remainder by water.

Production of crushed and broken limestone was reported from 61 counties, 12 of which had production exceeding 1 million tons. Those 12—Cook, Du Page, Hardin, Kankakee, La Salle, Lee, Livingston, Randolph, Rock Island, St. Clair, Vermilion, and Will—produced over 69 percent of the State total crushed and broken stone. Cook County alone contributed about one-third of the total. Dimension stone was produced in Kane, McHenry, and Union Counties.

Sulfur.—Shipments of elemental sulfur increased 7 percent in quantity and over 46 percent in value. The Anlin Company of Illinois recovered sulfur by the Amine-

Table 11.—Limestone and dolomite sold or used by producers, by uses

Use	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough construction:				
Irregular-shaped stone......thousand short tons..	-------	-------	[1]	$7
Rubble..............do....	2	$19	5	6
Dressed architectural:				
Cut..............thousand cubic feet..	3	26	[1]	11
House stone veneer..............do....	22	51	7	22
Sawed..............do....	-------	-------	1	4
Flagging..............do....	13	14	38	52
Total dimension...approximate thousand short tons..	5	110	9	102
Crushed and broken:				
Concrete aggregate and roadstone:				
Concrete aggregate.........thousand short tons..	NA	NA	9,743	14,340
Bituminous aggregate..............do....	NA	NA	8,168	11,350
Macadam aggregates..............do....	NA	NA	6,757	10,020
Dense graded road base stone..............do....	NA	NA	13,368	18,586
Surface treatment aggregates..............do....	NA	NA	6,201	8,682
Total aggregate and roadstone [2]..............do....	37,958	52,264	44,236	62,980
Agricultural limestone..............do....	3,879	5,983	4,799	7,623
Asphalt filler..............do....	30	128	119	551
Cement..............do....	2,724	2,334	2,711	2,318
Flux..............do....	W	W	936	1,320
Railroad ballast..............do....	561	630	204	255
Riprap and jetty stone..............do....	636	1,203	673	1,090
Other [3]..............do....	2,663	4,103	2,168	3,946
Total crushed and broken [2]..............do....	48,452	66,644	55,848	80,083
Grand total [2]..............do....	48,457	66,754	55,857	80,186

NA Not available.
W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Less than ½ unit.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes limestone for terrazzo and exposed aggregate (1968); chemical uses; dead-burned dolomite; lime; filter uses; mine dusting; poultry grit and mineral food; stone sand; whiting or whiting substitute and other fillers or extenders; other and unspecified uses; and item indicated by symbol W.

Gas-Purification and Modified-Claus processes at its Hartford plant in Madison County. The Pure Oil Co., a Division of Union Oil Co. of California, recovered sulfur by the Modified-Claus process at its Lemont plant in Will County.

Tripoli (Amorphous Silica).—Crude material was recovered from underground mines in Alexander County by Illinois Minerals Co. near Elco, and Tamms Industries Co. near Tamms. Production of crude material increased 6 percent in quantity and 5 percent in value. Output of prepared material increased 10 percent in quantity but decreased 7 percent in value. Prepared material was used for abrasives, filler, and other purposes.

Vermiculite.—Crude vermiculite mined outside the State was processed at plants operated by three companies in Cook, De Kalb, and Macoupin Counties. Output of exfoliated vermiculite which was used for insulation, concrete and plaster aggregate, masonry fill, and agricultural purposes, increased 37 percent in quantity and 38 percent in value.

METALS

Lead and Zinc.—Production of recoverable lead metal decreased 38 percent, and output of zinc metal decreased 11 percent. The substantial decrease in lead and zinc metal output was due primarily to the decreased production of fluorspar. Southern Illinois producers recovered lead and zinc as byproducts from their fluorspar operations. The total value of lead produced declined nearly 42 percent, while the value of zinc declined a little more than 13 percent. Average weighted yearly prices were 13.21 cents per pound for lead and 13.50 cents per pound for zinc, compared with 14.00 cents for lead and 13.84 cents for zinc in 1967. Principal producers were Eagle-Picher Industries, Inc., in northern

Illinois, and Aluminum Company of America (Alcoa), Minerva Oil Co., and Ozark-Mahoning Co., in southern Illinois. Alcoa ceased operations at Rosiclare in March when its stockpile of crude ore was depleted. Eagle-Picher Industries, Inc., operated the Blackjack, Rehm-Bauer, and Bautsch mines. First production from the latter property, which was last operated by Tri-State Zinc, Inc., in 1963, was in July.

Pig Iron and Steel.—About 6.3 million tons of pig iron, valued at $351.0 million, was shipped from Illinois blast furnaces or was consumed by the producing companies. This output represented an increase of 1 percent from 1967 production. Pig iron was produced by five companies operating blast furnaces in Granite City and South Chicago. Granite City Steel Co.'s production was curtailed for 3½ months due to a blast furnace failure at the same time they were relining and modernizing another furnace. Of the 19 blast furnaces in the State, three were inactive the entire year (two of which were abandoned), 13 were out of blast part of the year, and three operated throughout the year.

About 3.5 million short tons of domestic iron and manganiferous ores (excluding agglomerates), 3.0 million tons of sinter, and 4.4 million tons of pellets were consumed in Illinois blast furnaces. Iron-ore pellet consumption increased over 58 percent.

The iron and steel industry consumed about 2.2 million short tons of limestone and dolomite—about 51 percent in blast furnaces, 26 percent in agglomerating plants, and 23 percent in steel furnaces. Nearly 4 million short tons of coke was consumed by blast furnaces. Illinois agglomerating plants consumed 2.5 million short tons of iron ore. Data for nonintegrated steel plants are not included.

According to the American Iron & Steel Institute, steel production in Illinois was 10.5 million tons, a decrease of 1 percent from the 1967 quantity.

Other Metals.—American Zinc Co. recovered byproduct cadmium at its Monsanto plant and byproduct cadmium and germanium from domestic zinc ores at its Fairmont City plant. The latter plant has been closed and is being dismantled. Both plants are in St. Clair County. The New Jersey Zinc Co. recovered cadmium as a byproduct of domestic zinc ore at its Depue plant, in Bureau County. The multimillion-dollar expansion program at their plant includes Fluid Column zinc roasters (the first of its kind in the United States) and a 1,200-ton-per-day sulfuric acid plant. United Refining & Smelting Co. produced bismuth and cadmium and some low-melting alloys at its Franklin Park plant, in Cook County. American Potash & Chemical Corp. processed concentrates bearing thorium, rare-earth elements, and yttrium at its West Chicago plant, in Du Page County.

Table 12.—Mine production of lead and zinc, in terms of recoverable metals

Year	Mines producing	Crude ore sold or treated			Lead		Zinc		Total value [1] (thousands)
		Fluorspar-lead-zinc	Lead and/or zinc	Total	Short tons	Value (thousands)	Short tons	Value (thousands)	
1964	14	359,247	177,894	537,141	2,180	$571	13,800	$3,754	$4,825
1965	8	495,686	185,444	681,130	3,005	938	18,314	5,348	6,285
1966	8	520,891	128,088	648,979	2,285	691	15.192	4,406	5,096
1967	7	508,835	195,712	704,547	2,384	668	20,416	5,652	6,820
1968	7	440,265	204,687	644,952	1,467	388	19,937	4,909	5,297

[1] Data may not add to totals shown because of independent rounding.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Alpha Portland Cement Co.	15 S. 3d St. Easton, Pa. 18043	Portland, dry process	La Salle.
Marquette Cement Mfg. Co.	20 N. Wacker Dr. Chicago, Ill. 60606	Portland and masonry, dry process.	Do.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	do	Lee.
Missouri Portland Cement Co.	7751 Carondelet Ave. St. Louis, Mo. 63105	do	Massac.
Clays and shale:			
American Brick Co.	6558 W. Fullerton Ave. Chicago, Ill. 60635	Pit and plant	Cook.
Hydraulic-Press Brick Co. (Illinois Streator Div.)	705 Olive St. St. Louis, Mo. 63101	do	La Salle.
		Pit	Livingston.
		Pit and plant	Marshall.
		Pit	Mercer.
		Pit and plant	St. Clair.
Illinois Brick Co.	228 N. La Salle St. Chicago, Ill. 60601	do	Cook.
Illinois Clay Products Co. (Div. A. P. Green Refractories Co.)	Box 64 Morris, Ill. 60450	do	Grundy.
Marblehead Lime Co. (General Dynamics Corp.)	300 W. Washington St. Chicago, Ill. 60606	do	La Salle.
Marquette Cement Mfg. Co.	20 N. Wacker Dr. Chicago, Ill. 60606	Pit	Do.
Richards Brick Co.	234 Springer Ave. Edwardsville, Ill. 62025	do	Bond.
Southern Clay Co., Inc.	N. Edward St. Cassopolis, Mich. 49031	Pit and plant	Pulaski.
Western Brick Co. (Div. of Illinois Brick Co.)	Box 591 Danville, Ill. 61832	do	Vermilion.
Coal (bituminous):			
Ayrshire Collieries Corp.:	430 Big Four Bldg. 105 S. Meridian St. Indianapolis, Ind. 46225		
Sun Spot		Strip mine, cleaning plant.	Fulton.
Harmattan		do	Vermilion.
Delta		do	Williamson.
Barbara Kay Coal, Inc.	Box 397 Marion, Ill. 62959	Underground mine, cleaning plant.	Do.
Bell & Zoller Coal Co.	Box 100 Johnston City, Ill. 62951	do	Do.
Belle Valley Coal Co., Inc.	Route 1 Belleville, Ill. 62220	do	St. Clair.
Blue Bird Coal Co.	Box 369 Harrisburg, Ill. 62946	Underground mine	Willamson.
Florida Coal Co.	1724 Railway Exchange Bldg. 611 Olive St. St. Louis, Mo. 63101	Underground mine, cleaning plant.	Macoupin.
Freeman Coal Mining Corp.:	307 N. Michigan Ave. Chicago, Ill. 60601		
Orient No. 5		Underground mine, cleaning plant.	Franklin.
Orient No. 3		do	Jefferson.
Orient No. 6		Underground mine	Do.
Crown		Underground mine, cleaning plant.	Montgomery. CLOSED 12/71
Orient No. 4		do	Williamson.
Inland Steel Co.	30 W. Monroe St. Chicago, Ill. 60603	do	Jefferson.
Moffat Coal Co.	Box 74 Murdock, Ill. 62941	do	Douglas.
Old Ben Coal Corp.:	10 S. Riverside Plaza Chicago, Ill. 60606		
Old Ben No. 9		do	Franklin.
Old Ben No. 21		do	Do.
Old Ben No. 24		Underground mine	Do.
Old Ben No. 26		Underground mine, cleaning plant.	Do.
Peabody Coal Co.:	801 N. Memorial Dr. St. Louis, Mo. 63102		
No. 10		do	Christian.
Eagle		Strip and underground mines, cleaning plant.	Gallatin.
Northern Illinois		Strip mine	Grundy and Will.
		Cleaning plant	Kankakee.
Bright Star		Strip mine, cleaning plant.	Fulton.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activitv	County
Coal—Continued			
Peabody Coal Co.—Continued	301 N. Memorial Dr.		
Middle Grove	St. Louis, Mo. 63102	Strip mine, cleaning plant.	Fulton and Knox.
Mecco		do	Knox.
Edwards		do	Peoria.
Elm		do	Do.
Midwest		Strip and underground mines, cleaning plant.	St. Clair.
River King		Strip mine, cleaning plant.	Do.
Will Scarlet		do	Saline and Williamson.
Allendale		do	Stark.
Energy		do	Williamson.
Sahara Coal Co., Inc.:	59 E. Van Buren St		
No. 5	Chicago, Ill. 60605	Underground mine	Saline.
No. 6		Strip mine, cleaning plant.	Do.
No. 16		Underground mine	Do.
Sherwood-Templeton Coal Co., Inc.	5610 Crawfordsville Rd. Suite 2003 Indianapolis, Ind. 46208	Strip mine, cleaning plant.	Peoria.
Southwestern Illinois Coal Corp.:	1514 Merchants Bank Bldg.		
Captain	Indianapolis, Ind. 46204	do	Perry.
Streamline		Strip mine	Do.
		Cleaning plant	Randolph.
Tab Mining Co., Inc	Box 503 Marion, Ill. 62959	Strip mine	Jackson.
Truax-Traer Coal Co., Div. Consolidation Coal Co., Inc.:	Box 218		
Hillsboro	Pinckneyville, Ill. 62674	Underground mine	Montgomery.
Red Ember		Strip mine, cleaning plant.	Fulton.
Burning Star No. 2		do	Perry.
Burning Star No. 3		do	Randolph.
The United Electric Coal Cos.:	307 N. Michigan Ave.		
Cuba No. 9	Chicago, Ill. 60601	Strip mine, cleaning plant.	Fulton.
Buckheart No. 17		do	Do.
Banner No. 27		do	Peoria.
Fidelity No. 11		do	Perry.
Zeigler Coal & Coke Co.: Spartan.	208 S. La Salle St. Chicago, Ill. 60604	Underground mine, cleaning plant.	Randolph.
Coke:			
General Motors Corp	7–210 General Motors Bldg. Detroit, Mich. 48202	Coke ovens	Lake.
Granite City Steel Co	Box 367 Granite City, Ill. 62041	do	Madison.
Interlake Steel Corp	135th St. & Perry Ave. Chicago, Ill. 60627	do	Cook.
International Harvester Co	401 N. Michigan Ave. Chicago, Ill. 60611	do	Do.
Republic Steel Corp	1629 Republic Bldg. Cleveland, Ohio 44101	do	Do.
Fluorspar:			
Aluminum Company of America.	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	Processed stockpiled crude ore.	Hardin.
Minerva Oil Co.:	Eldorado, Ill. 62930		
Crystal Group		Underground mines, mill.	Do.
Minerva No. 1		Underground mine, mill.	Do.
Ozark-Mahoning Co	Box 57 Rosiclare, Ill. 62982	Underground mines	Hardin and Pope.
		Mill	Hardin.
Iron and steel:			
Granite City Steel Co	Box 367 Granite City, Ill. 62041	Iron and steel furnaces.	Madison.
Interlake Steel Corp	310 S. Michigan Ave. Chicago, Ill. 60604	Iron furnaces	Cook.
Republic Steel Corp	1629 Republic Bldg. Cleveland, Ohio 44101	Iron furnace and steel furnaces.	Do.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Iron and steel—Continued			
United States Steel Corp	3426 E. 89th St. Chicago, Ill. 60617	Iron and steel furnaces.	Cook.
Wisconsin Steel Division, International Harvester Co.	410 N. Michigan Ave. Chicago, Ill. 60611	do	Do.
Lead and zinc:			
Aluminum Company of America.	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	Processed stockpiled crude ore.	Hardin.
Eagle-Picher Industries, Inc.:	Box 1040 Galena, Ill. 61036		
Bautsch, Blackjack, and Rehm-Bauer.		Underground mines, ore processed at Graham mill.	Jo Daviess.
Graham mill			Do.
Minerva Oil Co.:	Eldorado, Ill. 62930		
Crystal Group		Underground mines, mill.	Hardin.
Minerva No. 1		Underground mine, mill.	Do.
Ozark-Mahoning Co	Box 57 Rosiclare, Ill. 62982	Underground mines Mill	Hardin and Pope. Hardin.
Lime:			
Marblehead Lime Co.:	300 W. Washington St. Chicago, Ill. 60606		
Marblehead Limekiln		Quicklime and hydrated lime, three shaft kilns.	Adams.
Quincy Limekiln		Quicklime, one calcimatic kiln.	Do.
South Chicago Limekiln		Quicklime and hydrated lime, four rotary kilns.	Cook.
Thornton Limekiln		do	Do.
Menke Stone & Lime Co	Room 506 Quincy, Ill. 62301	Quicklime and hydrated lime, two shaft kilns, one continuous hydrator.	Adams.
Standard Lime & Refractories Co. (Div. Martin Marietta Corp.).	2000 1st Nat'l. Bank Bldg. Baltimore, Md. 21203	Quicklime, three rotary kilns.	Cook.
Natural gas processing: U.S. Industrial Chemicals Co., Div. of National Distillers & Chemical Corp.	99 Park Ave. New York, N.Y. 10016		Douglas.
Peat:			
Anderson Peat Co	Morrison, Ill. 61270	Bog, processing plant	Whiteside.
Markman Peat Co	Route 3 Morrison, Ill. 61270	do	Do.
Expanded perlite:			
Filter Materials Corp	124 N. Buesching Rd. Lake Zurich, Ill. 60047	Processing plant	Lake.
Johns-Manville Perlite Corp., Building Products Div.	22 E. 40th St. New York, N.Y. 10016	do	Will.
Mica Pellets, Inc	1008 Oak St. De Kalb, Ill. 60115	do	De Kalb.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	do	Lake.
Ryolex Corp	310 E. Bradley Ave. Champaign, Ill. 61820	do	Champaign.
Silbrico Corp	6300 River Rd. La Grange, Ill. 60525	do	Cook.
U.S. Perlite Corp	Box 258 Momence, Ill. 60954	do	Kankakee.
Petroleum refineries:			
American Oil Co	910 S. Michigan Ave. Chicago, Ill. 60680		Madison.
Clark Oil & Refining Co	8530 W. National Ave. Milwaukee, Wis. 53227		Cook, Madison.
Marathon Oil Co	539 S. Main Findlay, Ohio 45840		Crawford.
Mobil Oil Corp	150 E. 42d New York, N.Y. 10017		St. Clair.
Shell Oil Co	50 W. 50th New York, N.Y. 10020		Madison.
Texaco Inc	135 E. 42d New York, N.Y. 10017		Lawrence, Will.
Union Oil Co. of California	Union Oil Center Los Angeles, Calif. 90054		Will.
Sand and gravel:			
Arrowhead Silica Corp	Troy Grove, Ill. 61372	Pit; stationary plant	La Salle.
Bellrose Silica Co	307 Central Life Bldg. Ottawa, Ill. 61350	do	Do.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Chain O Lakes Sand & Gravel Co., Evanston Fuel & Material Co.	Fox Lake, Ill. 60020	Pit; stationary plant	McHenry.
Chicago Gravel Co	343 S. Dearborn St. Chicago, Ill. 60604	Pits; stationary plants.	Cook, Will.
Concrete Materials Division, Martin Marietta Corp.	4096 1st Ave. NE. Cedar Rapids, Iowa 52406	Pits; portable and stationary plants.	Ogle, Peoria, Tazewell, Woodford.
Elmhurst-Chicago Stone Co	400 W. 1st St. Elmhurst, Ill. 60126	Pits; stationary plants.	Du Page, Will.
Illinois-Wisconsin Sand & Gravel Co.	Eastern Ave. South Beloit, Ill. 61080	Pit; dredge; stationary plant.	Winnebago.
Kenny & Palumbo	Bureau Junction, Ill. 61315	Pit	Bureau.
Kishwaukee Sand & Gravel Co., Shappert Engineering Co.	Belvidere, Ill. 61008	Dredge	Boone.
Larson Brothers Sand & Gravel.	1822 S. Fifth St. Rockford, Ill. 61108	Pits; portable and stationary plants.	Winnebago.
McHenry Sand & Gravel Co., Inc.	920 N. Front St. McHenry, Ill. 60050	Pits; portable plants	McHenry.
Manley Sand Division, Martin Marietta Corp.	Rockton, Ill. 61072	Pit; stationary plant	Ogle.
Material Service Division, General Dynamics Corp.	300 W. Washington Chicago, Ill. 60606	Pits; stationary plants.	Cook, Grundy, Kane, McHenry, Will.
Meyer Aggregate	Box 56, Route 2 Algonquin, Ill. 60102	Pits; portable and stationary plants.	McHenry.
Meyer Aggregate West Division.		do	Kane, Kendall, Will.
Moline Consumers Co	313-16th St. Moline, Ill. 61265	do	Bureau, La Salle, Rock Island.
Ottawa Silica Co	Box 577 Ottawa, Ill. 61350	Pit; stationary plant	La Salle.
Road Materials Corp., E. M. Melahn Construction Co., Inc.	Box 205 East Dundee, Ill. 60118	Pits; stationary plants.	Kane, McHenry.
Rowe Construction Co. R. A. Cullinan & Son.	1523 W. Market St. Bloomington, Ill. 61701	Pits; portable and stationary plants.	Livingston, McLean.
Edward Schneider	Route 3, Box 72 Elgin, Ill. 60120	do	Kane.
Strunk Brothers Co	Tiskilwa, Ill. 61368	Pit; portable plant	Bureau.
Thelen Sand & Gravel	Route 3, Box 330 Antioch, Ill. 60002	Pit; portable and stationary plant.	Lake.
Vulcan Materials Co. Midwest Division.	29 N. Wacker Dr. Chicago, Ill. 60606	Pits; stationary plants.	Kane, Lake, McHenry.
Wedron Silica Co	135 S. La Salle St. Chicago, Ill. 60603	Pit; stationary plant	La Salle.
Smelters and refineries:			
American Smelting & Refining Co.	120 Broadway New York, N.Y. 10005	Zinc secondary plant	Clinton.
American Zinc Co	20 S. 4th St. St. Louis, Mo. 63101	do	Montgomery.
		Zinc primary plants	St. Clair.
Apex Smelting Co	2537 W. Taylor St. Chicago, Ill. 60612	Zinc secondary plant	Cook.
Continental Smelting & Refining Co.	7751 W. 47th Lyons, Ill. 60534	Lead secondary plant	Do.
Goldsmith Div. of National Lead Co.	900 W. 18th St. Chicago, Ill. 60608	do	Do.
Imperial Type Metal Co	3400 Aramingo Ave. Philadelphia, Pa. 19134	do	Do.
National Lead Co	111 Broadway New York, N.Y. 10006	do	Do.
		do	Madison.
The New Jersey Zinc Co	160 Front St. New York, N.Y. 10038	Zinc primary plant	Bureau.
Sandoval Zinc Co	3649 S. Albany Ave. Chicago, Ill. 60632	Zinc secondary plant	Marion.
Stone:			
Limestone and dolomite:			
Charleston Stone Co	Box 280 Charleston, Ill. 61920	Quarries; stationary plant.	Coles.
Columbia Quarry Co	1007 Washington Ave. St. Louis, Mo. 63101	Quarries; stationary plants.	Massac, Pulaski, St. Clair.
		Underground mine; stationary plant.	Monroe.
East St. Louis Stone Co.	528 Murphy Bldg. E. St. Louis, Ill. 62201	Quarry; stationary plant.	St. Clair.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone and dolomite—Continued			
Elmhurst-Chicago Stone Co.	400 W. 1st St. Elmhurst, Ill. 60126	Quarry; stationary plant.	Du Page.
D-P Indian Point Limestone Products, Inc.	Box 126 Mason City, Ill. 62664	do	Menard.
Industrial Chemicals Div. Allied Chemicals Corp.	Box 70 Morristown, N.J. 07960	do	Randolph.
Lehigh Stone Corp.	Box 669 Kankakee, Ill. 60901	Quarries; stationary plant.	Clark, Kankakee.
Lincoln Stone Quarry, Inc.	Box 6 Joliet, Ill. 60434	Quarry; stationary plant.	Will.
Manteno Limestone Co.	Box 509 Manteno, Ill. 60950	do	Kankakee.
Marquette Cement Mfg. Co.	20 N. Wacker Dr. Chicago, Ill. 60606	do	La Salle.
Material Service Div. General Dynamics Corp.	300 W. Washington St. Chicago, Ill. 60606	Quarries; stationary plants.	Cook, Vermilion, Will.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	Quarry; stationary plant.	Lee.
Midwest Stone Co.	Box 180 Anna, Ill. 62906	Quarry; portable plant.	Union.
Mississippi Lime Co.	7 Alby St., Box 247 Alton, Ill. 62002	Underground mine; stationary plant.	Madison.
Missouri Portland Cement Co.	7751 Cardondelet Ave. St. Louis, Mo. 63105	Quarry; stationary plant.	Hardin.
Moline Consumers Co.	313 16th St. Moline, Ill. 61265	Quarries; stationary and portable plants.	Adams, Brown, Henry, Pike, Rock Island, Warren.
Pontiac Stone Co.	Route 23, Box 412 Pontiac, Ill. 61764	Quarry; stationary plant.	Livingston.
Rein, Schultz & Dahl, Inc.	6217 Nesbitt Rd. Madison, Wis. 53711	Quarries; portable plants.	Carroll, Jo Daviess, Ogle, Stephenson, Whiteside.
River Sand & Stone Co. (Ryan Contracting Co., Inc.).	Box 5047, Lawndale Branch 5416 Boonville Hwy. Evansville, Ind. 47715	Quarry; underground mine; stationary plant.	Hardin.
Rockford Blacktop Construction Co.	600 Boylston St. Loves Park, Ill. 61111	Quarries; portable plants.	Boone, Winnebago.
Southern Illinois Stone Co.	Box 38 Buncombe, Ill. 62912	Quarry; stationary plant.	Johnson.
Vulcan Materials Co. Midwest Division.	29 N. Wacker Dr. Chicago, Ill. 60606	Quarries; stationary plants.	Cook, Will.
Sandstone: Virgil Bridges	Elco, Ill. 62929	Underground mine	Alexander.
Recovered sulfur:			
The Anlin Company of Illinois.	Box 6554 Houston, Texas 77005	Byproduct sulfur recovery.	Madison.
The Pure Oil Co., Div. of Union Oil Co. of California.	200 E. Golf Rd. Palatine, Ill. 60067	do	Will.
Tripoli (amorphous silica):			
Illinois Minerals Co.	218 10th St. Cairo, Ill. 62914	Underground mine	Alexander.
Tamms Industries Co.	Box 64 Lyons, Ill. 60534	do	Do.
Exfoliated vermiculite:			
International Vermiculite Co.	1st & Mound Sts. Girard, Ill. 62640	Processing plant	Macoupin.
Mica Pellets, Inc.	1008 Oak St. De Kalb, Ill. 60115	do	De Kalb.
Zonolite Division, W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 01109	do	Cook.

The Mineral Industry of Indiana

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey, Indiana Department of Natural Resources, for collecting information on all minerals except fuels.

By Donald F. Klyce [1] and Mary B. Fox [2]

In 1968, the value of mineral production in Indiana totaled $235.4 million, about 4 percent less than the record high established in 1967. Smaller outputs of cement, coal, gypsum, and petroleum accounted for most of the decline. Clays, sand and gravel, and stone production was near the 1967 level, and only lime production showed a significant increase over the 1967 output. Nonmetals accounted for 58 percent of the State's mineral production value. The remainder represented the value of mineral fuels, as no metallic ores were mined in the State.

Mineral production was reported from 86 of the 92 counties in Indiana. Nearly half (48 percent) the value of State mineral production came from six counties—Clark, Lake, Lawrence, Putnam, Sullivan, and Warrick. In these counties all of the lime, most of the cement, three-fifths of the coal, and large quantities of building and crushed stone, sand and gravel, and clay were produced. Data on the value of petroleum and natural gas are not available at the county level, but about two-thirds of the State's petroleum output came from Gibson and Posey Counties. Twenty-eight counties had mineral production valued at $1 million or more and accounted for 79 percent of the value of State mineral production.

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[2] Mineral statistician, Geological Survey, Indiana Department of Natural Resources, Bloomington, Ind.

Table 1.—Mineral production in Indiana [1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Abrasives (whetstones) short tons	5	$16	5	$16
Cement, portland thousand 376-pound barrels	15,924	53,123	14,774	48,096
Clays thousand short tons	1,489	2,126	1,550	2,355
Coal (bituminous) do	18,772	73,419	18,486	71,680
Natural gas million cubic feet	198	46	234	55
Peat short tons	42,962	441	38,763	557
Petroleum (crude) thousand 42-gallon barrels	10,081	30,041	8,692	26,511
Sand and gravel thousand short tons	26,265	25,588	25,774	26,160
Stone do	26,977	46,725	26,307	46,790
Value of items that cannot be disclosed: Masonry cement, gypsum, and lime	XX	13,396	XX	18,166
Total	XX	244,921	XX	235,386
Total 1957–59 constant dollars	XX	245,978	XX	p 231,490

p Preliminary. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

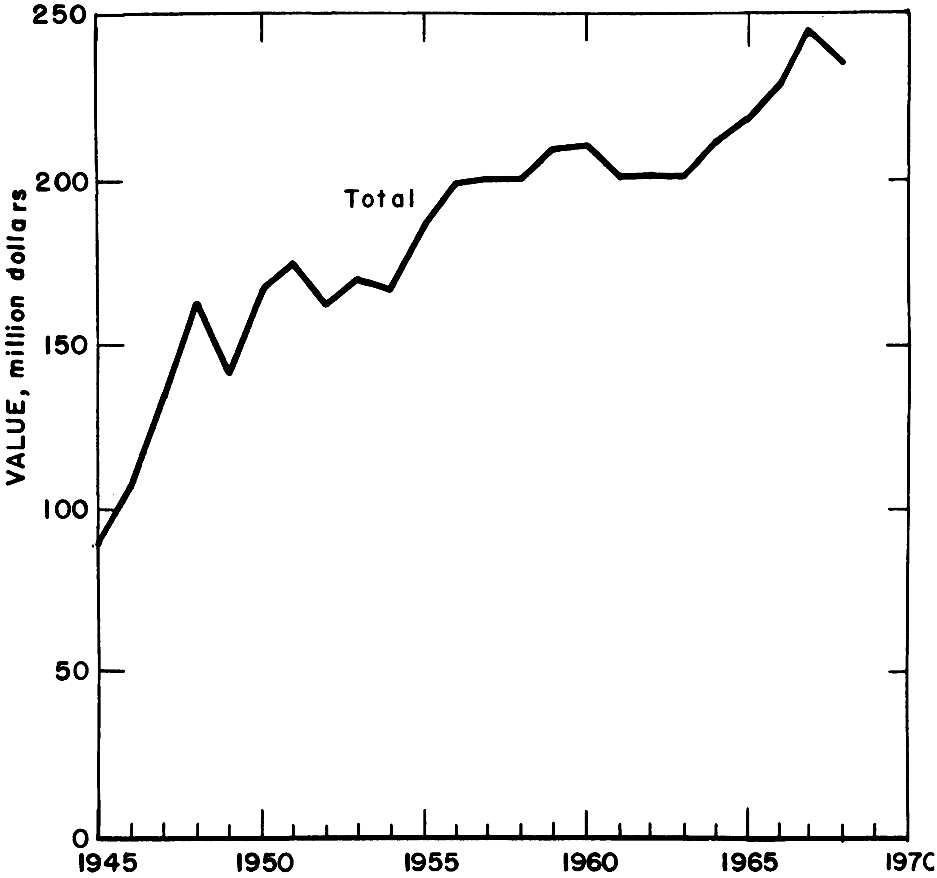

Figure 1.—Total value of mineral production in Indiana.

Table 2.—Value of mineral production in Indiana, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Adams	$794	$721	Stone, sand and gravel, clays.
Allen	2,855	3,117	Stone, sand and gravel.
Bartholomew	W	W	Stone.
Blackford	W	W	Stone, clays.
Boone	137	145	Sand and gravel.
Carroll	W	W	Stone, sand and gravel.
Cass	W	W	Cement, stone, sand and gravel, clays.
Clark	W	W	Do.
Clay	W	W	Coal, clays.
Clinton	W	21	Sand and gravel.
Crawford	W	W	Stone.
Daviess	W	W	Sand and gravel, coal.
Dearborn	236	240	Sand and gravel.
Decatur	390	399	Stone.
De Kalb	368	381	Sand and gravel.
Delaware	1,361	1,270	Stone, sand and gravel.
Dubois	1	12	Clays.
Elkhart	496	537	Sand and gravel, stone.
Fayette	287	307	Sand and gravel.
Floyd	W	W	Stone.

See footnote at end of table.

Table 2.—Value of mineral production in Indiana, by counties[1]—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Fountain	$621	W	Sand and gravel, coal, clays.
Franklin	W	$60	Sand and gravel, stone, clays.
Fulton	198	215	Sand and gravel.
Gibson	W	W	Coal, sand and gravel.
Grant	W	W	Stone, sand and gravel, peat.
Greene	8,633	W	Coal, sand and gravel, clays.
Hamilton	2,487	3,985	Sand and gravel, stone.
Hancock	55	75	Sand and gravel.
Harrison	1,380	1,340	Sand and gravel, stone.
Hendricks	W	W	Sand and gravel.
Henry	W	397	Do.
Howard	W	W	Stone, sand and gravel.
Huntington	1,636	W	Stone, sand and gravel, clays.
Jackson	385	411	Sand and gravel, clays.
Jasper	W	875	Stone, sand and gravel.
Jay	W	W	Do.
Jefferson	W	---------	
Jennings	328	380	Stone.
Johnson	W	W	Sand and gravel.
Knox	739	507	Sand and gravel, coal.
Kosciusko	614	614	Sand and gravel, stone.
Lagrange	294	277	Do.
Lake	W	W	Cement, lime, sand and gravel, clays.
La Porte	W	W	Sand and gravel, peat.
Lawrence	16,417	16,993	Cement, stone.
Madison	2,105	2,071	Stone, sand and gravel.
Marion	W	W	Sand and gravel, peat.
Marshall	176	246	Sand and gravel, stone, peat.
Martin	W	W	Gypsum.
Miami	414	W	Sand and gravel.
Monroe	8,298	6,811	Stone.
Montgomery	109	192	Clays, sand and gravel.
Morgan	970	1,005	Clays, sand and gravel, stone.
Newton	W	W	Stone.
Noble	220	294	Sand and gravel, stone.
Orange	719	750	Stone, abrasives.
Owen	1,128	977	Stone, sand and gravel, clays, coal.
Parke	323	336	Sand and gravel, coal, clays.
Perry	W	W	Stone.
Pike	W	W	Coal, stone.
Porter	W	W	Sand and gravel, clays.
Posey	W	W	Sand and gravel.
Pulaski	W	W	Stone, clays, sand and gravel.
Putnam	12,299	12,061	Cement, stone, sand and gravel.
Randolph	341	W	Stone, sand and gravel.
Ripley	425	443	Stone.
Rush	315	409	Stone, sand and gravel.
St. Joseph	718	W	Sand and gravel, stone.
Scott	305	409	Stone.
Shelby	1,262	1,280	Stone, sand and gravel.
Spencer	W	W	Coal, stone.
Starke	37	37	Sand and gravel.
Steuben	W	573	Sand and gravel, stone.
Sullivan	15,314	W	Coal, sand and gravel, stone.
Switzerland	W	W	Sand and gravel, stone.
Tippecanoe	W	W	Sand and gravel.
Union	18	18	Do.
Vermillion	369	459	Sand and gravel, clays.
Vigo	3,210	2,360	Coal, sand and gravel.
Wabash	498	462	Stone, sand and gravel.
Warren	W	W	Sand and gravel, peat.
Warrick	W	W	Coal, stone, sand and gravel.
Washington	W	W	Stone.
Wayne	W	W	Sand and gravel, stone.
Wells	W	W	Stone, peat.
White	384	W	Stone.
Whitley	W	W	Sand and gravel.
Undistributed [2]	154,256	170,911	
Total [3]	244,921	235,386	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Data for petroleum and natural gas are not available on a county basis; however, value for these commodities are included with "Undistributed." Benton, Brown, Ohio, Tipton, and Vanderburgh Counties are not listed because no production was reported.

[2] Includes value for petroleum, natural gas, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Indiana business activity

	1967	1968	Change (percent)
Employment and labor force, annual average: [1]			
Total labor force ..... thousands	[r] 2,077.1	2,104.0	+1.3
Agricultural employment ..... do	62.4	58.2	−6.7
Nonagricultural employment [2] ..... do	[r] 1,942.6	1,972.7	+1.5
Manufacturing ..... do	[r] 716.0	717.2	+.2
Construction ..... do	[r] 80.6	86.4	+7.2
Mining and quarrying ..... do	[r] 7.3	7.4	+1.4
Primary metal industries ..... do	110.7	110.0	−.6
Steel mills ..... do	67.0	67.3	+.4
Stone, clay, and glass products ..... do	[r] 25.7	24.1	−6.2
All other ..... do	1,138.7	1,161.7	+2.0
Payrolls, manufacturing [3] ..... millions	[r] $5,083.9	$5,512.6	+8.4
Personal income:			
Total ..... do	$15,890	[p] $17,314	+9.0
Per capita	$3,188	[p] $3,421	+7.3
Construction activity:			
Building permits: [4]			
Valuation of authorized residential construction ..... millions	$343.0	$360.9	+5.2
Number of private and public residential units authorized	26,595	27,715	+4.2
Contract construction work performed:			
Total ..... millions	[r] $1,422	$1,505	+5.8
Nonresidential building ..... do	$590	$635	+7.6
Residential building ..... do	[r] $494	$597	+20.8
Nonbuilding ..... do	$338	$274	−18.9
State highway commission contracts awarded ..... do	$134.3	$131.5	−2.1
Portland cement shipments to and within Indiana thousand 376-pound barrels	10,699	10,218	−4.5
Retail sales ..... millions	$8,259	$8,810	+6.7
Farm marketing, cash receipts ..... do	[r] $1,356	[p] $1,352	−.3
Mineral production ..... do	$244.9	$235.4	−3.9
Raw steel production ..... do	[r] $17,610	$17,911	+1.7
Utility production and consumption:			
Production of electric energy by electric utilities million kilowatt hours	44,232	[p] 48,024	+8.6
Natural gas consumption ..... million cubic feet	434,632	454,013	+4.5

[p] Preliminary. [r] Revised.

[1] Adjusted to March 1968 benchmark levels.

[2] Includes nonagricultural wage and salary, self-employed, unpaid family workers, and domestic workers in private households.

[3] Includes workers covered under the Indiana Employment Security Law.

[4] Based on a Nationwide universe of 13,000 permit issuing places.

Sources: Indiana Employment Security Division in cooperation with the U.S. Department of Labor, Construction Reports, Statistical Abstract of the United States, Indiana State Highway Commission, Sales Management, Farm Income Situation, and Federal Power Commission.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	2,017	270	545	4,249	8	126	31.53	12,295
Peat	25	228	6	46	-------	2	43.94	857
Nonmetal	887	257	228	1,798	-------	24	13.35	280
Sand and gravel	1,111	232	257	2,227	1	44	20.20	5,009
Stone	3,162	279	883	7,277	-------	127	17.45	646
Total	7,202	266	1,919	15,597	9	323	21.29	4,401
1968: p								
Coal	2,265	254	577	4,638	4	156	34.50	6,318
Peat	30	186	6	45	-------	1	22.38	2,126
Nonmetal	720	277	200	1,574	1	22	14.61	4,059
Sand and gravel	1,010	241	243	2,112	1	38	18.47	3,215
Stone	2,780	271	754	6,238	2	128	20.84	2,583
Total [1]	6,810	261	1,779	14,607	8	345	24.17	4,018

p Preliminary.

[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Materials.—Whetstones were fabricated at a mill near Orleans from sandstone quarried in Orange County.

Cement.—Shipments of portland cement decreased about 7 percent, while masonry cement output was 5 percent larger than in 1967. Portland cement was produced at five plants, of which four also produced masonry cement. The average mill value of portland cement was $3.26 per barrel compared with $3.34 per barrel in 1967. Average value of masonry cement was $2.58 per barrel, down from $3.09 in the previous year. Yearend stocks of portland cement were 2.0 million barrels compared with 2.2 million (adjusted) in 1967. About 91 percent of the portland cement shipped was types I and II (general use and moderate heat); the remainder was type III (high-early-strength) and portland slag and block. About 38 percent of the portland cement shipped was used within the State. Out-of-State shipments went principally to Illinois, Kentucky, and Wisconsin. Nearly 4.7 million barrels of portland cement were shipped into Indiana from plants located in other States, principally Michigan and Ohio.

More than 3.3 million tons of limestone and 1.0 million tons of slag, clays and shale, gypsum, sand, air-entraining compounds, and grinding aids were used in manufacturing portland cement. About 321 million kilowatt-hours of electrical energy was used at the plants. The dry process of manufacture was used at three plants and the wet process at two plants.

Annual finished portland cement capacity of Indiana plants increased to 18.7 million barrels from 18.4 million in 1967.

More than 61 percent of the shipments were purchased by ready-mixed concrete companies with the remainder going principally to highway contractors (16 percent), concrete product manufacturers (13 percent), and building material dealers (5 percent). Highway contractors' purchases were about 13 percent larger than in 1967; purchases by other customers were less than in 1967.

About four-fifths of the portland cement was shipped by truck and the remainder by rail.

Lone Star Cement Corp. awarded a contract for its 4-million-barrel cement plant at Greencastle. The $25 million plant is scheduled to be in operation for the 1969 construction season. It will replace a 2.7-million-barrel plant at the same location.

Clays.—Clay production was reported from 36 clay and shale pits operated by 27 companies in 19 counties.

Table 5.—Clays sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Fire clay		Miscellaneous clay		Total [1]	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	376	$644	1,169	$1,620	1,545	$2,264
1965	329	526	1,180	1,634	1,459	2,160
1966	314	511	1,177	1,685	1,491	2,196
1967	247	420	1,242	1,706	1,489	2,126
1968	182	340	1,369	2,015	1,550	2,355

[1] Data may not add to totals shown because of independent rounding.

Output increased more than 4 percent and reflected a larger demand for materials for manufacturing heavy clay products, notably building brick and vitrified sewer pipe.

Fire clay production decreased 27 percent, and output of miscellaneous clay and shale increased more than 10 percent.

Figures compiled by the Indiana Geological Survey indicated that the value of products manufactured from Indiana clays and shale, excluding cement, was $22.2 million.

Gypsum.—Crude gypsum production, from two underground mines in Martin County, was slightly less than in 1967. Lath, plaster, and wallboard were manufactured at plants adjacent to the mines. A board plant was also operated at East Chicago in Lake County.

Lime.—The Marblehead Lime Co. operated a lime plant, the only lime-making facility in the State, at Buffington in Lake County. Production was substantially greater than in 1967. Nearly all of the output was used in manufacturing steel, principally at the northern Indiana steel mills. Indiana demand for lime exceeded 1.1 million tons. Substantial quantities were shipped into the State from Illinois, Ohio, Missouri, and Iowa.

Perlite.—Crude perlite, mined in Western States, was expanded at plants in Lake, Martin, and Scott Counties. The expanded product was used principally for building plaster, loose fill insulation, and concrete aggregate.

Sand and Gravel.—Sand and gravel output remained near the 1967 level of production. A slight decrease in production was more than offset by a 4-cent rise in average value per ton, increasing value of the 1968 output by more than 2 percent. There was little change in the use pattern, with building, paving, and fill materials accounting for more than 97 percent of production. Production was reported in 65 counties from 194 commercial and 31 government-and-contractor operations, consisting of 109 stationary plants, 51 portable plants, and 31 dredges.

More than 54 percent of the output came from 10 counties, with Marion County continuing to hold first place. Nearly 91 percent of the sand and gravel was transported by truck and the remainder by rail and water.

Slag (Iron-Blast Furnace).—Blast furnaces in Lake County produced a substantial tonnage of slag as a byproduct of pig iron production. The slag was used in manufacturing cement, mineral wool, and roofing granules; crushed for use as an aggregate; and expanded for lightweight aggregate.

Stone.—Total stone output decreased slightly from the record high production in 1967. Demand for crushed stone was about 3 percent less than in 1967, but dimension limestone output increased more than 11 percent. A smaller demand for aggregate and roadstone accounted for much of the decline in crushed stone production. Much of the dimension stone gain was in the production of rough construction stone and rough architectural block. Demand for dressed stone was less than in 1967.

Most of the dimension stone was produced in Lawrence and Monroe Counties from the Salem Limestone.

Crushed and broken limestone and dolomite was quarried and processed in several areas of the State, but nearly half of the production came from seven counties—Allen, Clark, Crawford, Huntington, Law-

Table 6.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	4,679	$4,130	4,588	$4,058
Paving	4,057	3,485	4,422	3,974
Fill	2,052	1,157	1,880	1,201
Railroad ballast	14	14	1	W
Industrial [1]	639	2,134	655	2,070
Other	68	52	99	83
Total	11,509	10,972	11,645	11,386
Gravel:				
Building	3,268	3,983	3,369	4,253
Paving	8,154	8,597	7,770	8,628
Railroad ballast	19	18	W	W
Fill	2,383	1,469	2,062	1,359
Other	7	10	10	10
Total	13,831	14,077	13,211	14,250
Total sand and gravel	25,340	25,049	24,856	25,636
Government-and-contractor operations:				
Sand:				
Paving	45	25	58	31
Fill	--------	--------	4	2
Total	45	25	62	33
Gravel:				
Paving	873	510	849	487
Fill	--------	--------	7	4
Other	7	4	--------	--------
Total	880	514	856	491
Total sand and gravel	925	539	918	524
All operations:				
Sand	11,554	10,997	11,707	11,419
Gravel	14,711	14,591	14,067	14,741
Total	26,265	25,588	25,774	26,160

W Withheld to avoid disclosing individual company confidential data; included with "Other."

[1] Includes blast (1967), engine, fire or furnace, glass, molding, pottery, porcelain, tile, and other industrial uses.

rence, Newton, and Putnam. Beginning with 1968, a more detailed breakdown of aggregate and roadstone is presented in table 8.

An investigation of crushed stone resources of the Devonian and Silurian carbonate rocks, from which most crushed stone is produced in Indiana, was completed by the Indiana Geological Survey.[3]

Calcareous marl, used for soil conditioning, was produced in seven counties with the largest production reported from Lagrange, Marshall, and Noble Counties. Output was 31 percent less than in 1967.

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[3] French, R. R. Crushed Stone Resources of the Devonian and Silurian Carbonate Rocks of Indiana. Indiana Geol. Survey Bull. 37, 1968, 127 pp.

Table 7.—Production of sand and gravel, by counties[1]

(Thousand short tons and thousand dollars)

County	1967		1968		County	1967		1968	
	Quantity	Value	Quantity	Value		Quantity	Value	Quantity	Value
Adams	111	$124	65	W	Marion	4,407	W	3,862	W
Allen	988	W	1,095	W	Marshall	196	$169	279	$239
Blackford	W	W	------	------	Miami	398	414	W	W
Boone	134	137	138	$145	Montgomery	64	W	68	W
Carroll	63	36	W	W	Morgan	387	304	W	W
Cass	W	W	143	130	Newton	W	W	------	------
Clark	685	W	540	476	Noble	287	216	431	289
Clinton	43	W	22	21	Owen	W	W	W	W
Daviess	63	58	56	57	Parke	288	241	W	W
Dearborn	211	236	207	240	Porter	W	W	W	W
De Kalb	411	368	411	381	Posey	W	W	(2)	(2)
Delaware	344	345	376	375	Pulaski	W	W	W	W
Elkhart	614	493	665	W	Putnam	W	W	W	W
Fayette	264	287	277	307	Randolph	57	42	27	26
Fountain	508	W	504	W	Rush	33	W	19	14
Franklin	88	62	69	48	St. Joseph	800	717	909	778
Fulton	209	198	271	215	Shelby	325	346	350	390
Gibson	117	W	W	W	Starke	48	37	47	37
Grant	320	W	W	W	Steuben	416	W	448	570
Greene	194	W	187	W	Sullivan	186	W	W	W
Hamilton	W	W	2,434	W	Switzerland	W	W	W	W
Hancock	75	55	102	75	Tippecanoe	W	W	W	W
Harrison	W	W	W	W	Union	33	18	33	18
Hendricks	W	W	W	W	Vermillion	180	W	265	W
Henry	W	W	378	397	Vigo	884	W	1,044	W
Howard	W	W	140	107	Wabash	151	W	150	148
Huntington	460	W	95	94	Warren	579	606	501	W
Jackson	299	232	235	259	Warrick	W	W	21	W
Jasper	85	85	W	W	Washington	W	W	------	------
Jay	72	48	16	18	Wayne	447	W	365	W
Johnson	W	W	W	W	Wells	W	W	------	------
Knox	640	W	584	W	Whitley	133	W	W	W
Kosciusko	677	612	734	W	Undistributed[3]	6,976	18,818	6,005	20,042
Lagrange	317	284	301	269					
Lake	W	W	W	W	Total	26,265	25,588	25,774	26,160
La Porte	W	W	W	W					
Madison	998	W	910	W					

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] No sand and gravel production reported from the following counties: Bartholomew, Benton, Brown, Clay, Crawford, Decatur, Dubois, Floyd, Jefferson, Jennings, Lawrence, Martin, Monroe, Ohio, Orange, Perry, Pike, Ripley, Scott, Spencer, Tipton, Vanderburgh, and White.

[2] Less than ½ unit.

[3] Includes production for which no county breakdown is available (1967), and data indicated by symbol W.

Table 8.—Limestone and dolomite sold or used by producers, by uses

Use	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough architectural thousand cubic feet	2,424	$3,202	2,607	$3,753
Other rough construction:				
Irregular-shaped stone thousand short tons	--------	--------	3	77
Rubble do	--------	--------	4	6
Dressed architectural:				
Cut thousand cubic feet	464	3,254	376	2,698
House stone veneer do	705	1,402	646	1,332
Sawed do	1,050	2,881	903	2,553
Flagging do	172	32	90	19
Total dimension approximate thousand short tons	349	[1] 10,772	388	10,438
Crushed and broken:				
Concrete aggregate and roadstone:				
Concrete aggregate thousand short tons	NA	NA	4,206	5,631
Bituminous aggregate do	NA	NA	2,767	4,129
Macadam aggregates do	NA	NA	2,864	4,014
Dense graded road base stone do	NA	NA	7,046	9,396
Surface treatment aggregates do	NA	NA	2,378	3,338
Total aggregate and roadstone do	20,597	27,266	19,261	26,508
Agricultural limestone do	1,888	2,781	2,098	3,220
Cement do	2,800	2,486	2,771	2,595
Railroad ballast do	425	551	440	584
Riprap and jetty stone do	592	1,810	937	2,203
Other [2] do	257	729	361	921
Total crushed and broken [1] do	26,558	35,623	25,867	36,031
Grand total [1] do	26,907	46,396	26,255	46,469

NA Not available.

[1] Data may not add to totals shown because of independent rounding.

[2] Includes stone used for stone sand (1967); asphalt filler and other fillers or extenders; filter stone; flux; mine dusting; other and unspecified uses.

Table 9.—Production of limestone[1] in 1968, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	Type of stone
Adams	W	W	Crushed and dimension.
Allen	W	W	Crushed.
Bartholomew	W	W	Do.
Blackford	W	W	Do.
Carroll	W	W	Do.
Cass	676	$804	Crushed and dimension.
Clark	2,659	3,351	Crushed.
Crawford	W	W	Do.
Decatur	267	399	Do.
Delaware	653	895	Do.
Floyd	W	W	Do.
Franklin	1	10	Dimension.
Grant	W	W	Crushed and dimension.
Hamilton	837	W	Crushed.
Harrison	246	W	Do.
Howard	W	W	Do.
Huntington	W	W	Do.
Jasper	W	W	Do.
Jay	114	W	Do.
Jennings	253	380	Do.
Lawrence	2,502	W	Crushed and dimension.
Madison	W	W	Crushed.
Monroe	1,132	6,811	Crushed and dimension.
Morgan	W	W	Crushed.
Newton	W	W	Do.
Orange	595	W	Do.
Owen	W	W	Do.
Perry	W	W	Do.
Pulaski	W	W	Do.
Putnam	2,798	W	Do.
Randolph	191	W	Do.
Ripley	302	443	Do.
Rush	W	395	Crushed and dimension.
Scott	290	409	Crushed.
Shelby	595	890	Crushed and dimension.
Sullivan	15	38	Crushed.
Switzerland	80	W	Do.
Wabash	188	314	Do.
Warrick	W	W	Do.
Washington	W	W	Do.
Wayne	142	228	Crushed and dimension.
Wells	W	W	Crushed.
White	W	W	Crushed and dimension.
Total	26,255	46,469	

W Withheld to avoid disclosing individual company confidential data; included in "Total."

[1] "Limestone" used generally to include dolomite.

Table 10.—Calcareous marl production

Year	Number of producers	Short tons	Value
1964	29	86,493	$52,335
1965	21	64,493	40,260
1966	21	61,532	38,778
1967	18	51,890	33,553
1968	13	35,828	28,311

Sandstone was quarried for building use in Lawrence, Orange, and Spencer Counties, with rubble being produced in Morgan County. In Pike County, sandstone was obtained from old coal mine spoilbanks and crushed for road use. Springs Valley Sandstone Co. did not operate the Sellers Quarry in Martin County in 1968, but opened a new quarry in Orange County. Hinkle Sandstone Co. discontinued quarrying stone in Monroe County.

Sulfur.—Byproduct sulfur was recovered from crude petroleum by the American Oil Co. at its Whiting refinery in Lake County. The Mathieson-Fluor process was used.

MINERAL FUELS

Coal (Bituminous).—Coal was produced from 44 mines (nine underground and 35 strip mines) in 13 counties. Ninety-three percent of the coal was mined in five counties with Warrick County accounting for nearly 41 percent of the State total. More than 15.3 million tons of coal was mechanically cleaned at 12 plants. Nearly 68 percent of the coal was transported by rail, of which 4 percent was unit train shipments, 13 percent by truck, 6 percent by water, and the remainder by conveyor, tram, and other methods. Nearly 68 percent of the coal mined was used for power generation by electric utility companies. About 40 million tons of coal was consumed in Indiana, of which 16.3 million was mined and used in the State.

During 1968, five coal mines, including the Chieftain and Victoria mines of Peabody Coal Co., were abandoned and two were idle. Three new coal mines, all of them strip mines, were opened during the year. Two of the mines, Peabody Coal Co.'s Latta mine in Green County and Ayrshire Collieries Corp. Ayrcoe mine in Pike County, are both large operations, with capacities of about 3,500 tons per day. The Ayrcoe mine output was shipped by unit train to the Bailey generating plant of Northern Indiana Public Service Co. Initial production from the new Dugger mine was reported in 1968.

Research conducted by the Indiana University Water Resources Research Center on coal mining effects on water quality in Sullivan County, led to the following conclusions:

1. That the magnitude and frequency of storm runoff has an appreciable effect on acid concentrations in a stream.
2. That the present surface-mining operations, except for coal-processing plants, are not the cause of acid water in the streams; rather, it is due mainly to old waste piles and compacted areas within the disturbed area, and underground mines.[4]

Coke.—Coke was produced at five plants, with output of 8.1 million tons, compared with 8.3 million tons in 1967. About 11.6 million tons of coal was carbonized at Indiana coke plants. None of the coking coal was mined in Indiana; most was shipped in from Illinois, Kentucky, Virginia, and West Virginia. State coke output was used chiefly in northern Indiana blast furnaces.

Peat.—Humus, moss, and reed-sedge peat were obtained from bogs in six counties. Nearly all of the peat was sold for soil improvement. None was sold for use as fuel.

Petroleum and Natural Gas.—Successful exploration during 1968 resulted in five new fields, nine new pools, and 11 extensions to existing pools. Four new fields, eight new pools, and eight extensions produce from Mississippian sediments; one new field and two extensions were in Ordovician (Trenton Limestone); and one new pool and one extension were completed in Pennsylvanian rocks.

A total of 162 exploratory wells were drilled during 1968, resulting in 20 oil wells, five gas wells, and 137 dry holes.

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[4] Corbett, D. M., and A. F. Agnew. Coal Mining Effect on Busseron Creek Watershed, Sullivan County, Indiana. Indiana Univ. Water Resources Research Center Rept. of Inv., No. 2, July 1968, 187 pp.

Table 11.—Coal (bituminous) production in 1968, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines operated		Production (thousand short tons)			Value (thousands)
	Underground	Strip	Underground	Strip	Total [1]	
Clay	--------	5	--------	1,063	1,063	$4,461
Daviess	--------	1	--------	10	10	W
Fountain	--------	1	--------	W	W	W
Gibson	2	1	860	10	870	W
Greene	--------	6	--------	2,357	2,357	W
Knox	1	--------	20	--------	20	W
Owen	--------	1	--------	W	W	W
Parke	--------	1	--------	12	12	64
Pike	1	5	35	2,748	2,783	W
Spencer	--------	1	--------	W	W	W
Sullivan	2	3	1,148	2,321	3,470	W
Vigo	1	1	74	234	308	W
Warrick	2	9	30	7,489	7,519	27,618
Total [1]	9	35	2,168	16,318	18,486	71,680

W Withheld to avoid disclosing individual company confidential data; included in "Total."
[1] Data may not add to totals shown because of independent rounding.

Table 12.—Shipments of bituminous coal for consumption in Indiana, by district of origin and consumer use

(Thousand short tons)

Use	District of origin [1]							Total
	2	3 and 6	4	7 and 8	9	10	11	
1964:								
Electric utilities	------	------	------	543	5,915	1,787	8,774	17,019
Coke and gas plants	------	84	------	11,381	------	391	------	11,856
Retail dealers	------	13	------	833	21	13	481	1,361
All others	------	15	3	314	405	1,283	3,629	5,649
Total	------	112	3	13,071	6,341	3,474	12,884	35,885
1965:								
Electric utilities	------	------	------	556	6,290	2,674	8,433	17,953
Coke and gas plants	------	407	------	11,141	------	376	------	11,924
Retail dealers	------	16	------	762	17	12	441	1,248
All others	------	4	------	435	343	1,113	3,865	5,760
Total	------	427	------	12,894	6,650	4,175	12,739	36,885
1966:								
Electric utilities	------	------	------	450	5,591	2,861	9,698	18,600
Coke and gas plants	------	622	------	11,083	------	541	------	12,246
Retail dealers	------	8	------	695	17	24	419	1,163
All others	10	------	------	422	306	1,197	4,480	6,415
Total	10	630	------	12,650	5,914	4,623	14,597	38,424
1967:								
Electric utilities	------	------	------	650	5,408	3,767	10,799	20,624
Coke and gas plants	------	393	------	11,288	------	640	------	12,321
Retail dealers	------	5	------	632	8	19	406	1,070
All others	------	4	------	432	263	1,090	4,637	6,426
Total	------	402	------	13,002	5,679	5,516	15,842	40,441
1968:								
Electric utilities	------	------	------	1,254	5,601	3,125	11,526	21,506
Coke and gas plants	------	253	------	10,182	------	1,103	------	11,538
Retail dealers	------	4	10	602	2	51	329	998
All others	------	------	------	388	230	1,133	4,452	6,208
Total	------	257	10	12,426	5,833	5,412	16,307	40,245

[1] States or portion of States represented by each district are as follows: District 2—Western Pennsylvania; 3 and 6—Northern West Virginia; 4—Ohio; 7 and 8—Eastern Kentucky, Southwestern Virginia, Southern West Virginia, and North Central Tennessee; 9—Western Kentucky; 10—Illinois; 11—Indiana.

Development wells numbered 156, resulting in 85 oil wells, 12 gas wells, 11 service wells, and 48 dry holes. Wells drilled for secondary recovery purposes totaled 150, and resulted in 31 oil wells, 89 input wells, 12 service wells, and 18 dry holes. Fifty-seven wells were drilled in search for, or development of, gas storage sites. There were 32 gas storage installations in the State, 29 of which were operative.

The number of drilling operations declined rather substantially from that of the previous year, but the percentage of successful completions was greater, particularly for the primary and secondary development wells. Drilling operations were conducted in 42 counties, but more than 50 percent of them were in Dubois, Gibson, Greene, Knox, Pike, Posey, and Spencer Counties, all in the southwestern part of the State.

Oil production during 1968 amounted to 8,691,749 barrels, a decrease of 1,389,403 barrels from the 1967 total. Secondary recovery methods accounted for 5,021,900 barrels of the total production.

The St. James Field, in Gibson County, was the site of the most significant drilling during the year. An exploratory well resulted in extension of the Renault sandstone reservoir, and subsequently 13 additional wells were completed successfully in the field. Another exploratory success, completed in the St. Louis Limestone (Mississippian), resulted in the discovery of a new pool.

Production of natural gas took a substantial upswing from 198 million cubic feet in 1967 to 234 million cubic feet in 1968. This was attributed to the initiation of production from the Plainville Field.

Table 13.—Crude petroleum production in 1968, by major fields

Name of field	Year discovered	Area (acres)	Location, county	Number of wells		Production (barrels)
				Producing	Completed	
Black River Consolidated	1950	680	Posey	NA	------	185,205
Caborn Consolidated	1940	1,870	Posey	NA	3	163,555
Coe South	1961	440	Pike	NA	------	133,030
College Consolidated	1941	770	Posey	NA	------	194,479
Evansville	1947	400	Vanderburgh	NA	------	129,022
Fleener	1940	150	Gibson	NA	1	102,660
Griffin Consolidated	1938	7,360	Gibson and Posey	NA	2	1,781,131
Heusler Consolidated	1938	2,180	Posey and Vanderburgh	NA	7	386,134
Mount Carmel Consolidated	1941	2,060	Gibson and Knox	NA	5	146,928
Mount Vernon Consolidated	1941	2,310	Posey	NA	2	382,063
Newtonville Consolidated	1943	520	Spencer	NA	------	104,733
Plainville	1950	350	Daviess	NA	------	112,174
Princeton North Consolidated	1943	1,040	Gibson	NA	1	139,256
Springfield Consolidated	1946	2,560	Posey	NA	1	668,511
Union-Bowman (New) Consolidated	1941	15,370	Gibson, Knox, and Pike	NA	20	482,792
Welborn Consolidated	1941	1,780	Posey	NA	1	241,770
Welborn North Consolidated	1953	380	Posey	NA	------	129,854
Wheatonville Consolidated	1949	1,640	Gibson	NA	2	217,058
Undistributed	XX	XX	------------------	NA	91	2,991,394
Total	XX	XX		[e] 3,621	[1] 136	8,691,749

[e] Estimate. NA Not available. XX Not applicable.
[1] Includes workovers without newly drilled footages.
Source: Petroleum Section, Indiana Geological Survey.

The proved oil reserve at the end of 1968 was 40,247,000 barrels; the total liquid hydrocarbon reserve was 40,291,000 barrels.[5]

Ten petroleum refineries had a total operating capacity of 588,800 barrels per stream day.[6]

METALS

Aluminum.—Aluminum Company of America operated a smelter at Newburgh that produced aluminum ingots and thin-gauge aluminum sheet. In August, the company announced plans to expand the capacity of the Newburgh operation by 50,000 tons, increasing capacity at the installation to a total of 225,000 tons. Initial production from the addition was expected in the spring of 1970.

Pig Iron and Steel.—Two plants in East Chicago and one in Gary produced pig iron and steel. Pig iron shipped or used by producers totaled 12.5 million tons compared with 12.2 million in 1967.

The American Iron & Steel Institute reported that steel production in Indiana increased to 17.9 million tons in 1968 from 17.6 million tons in 1967.

At the Bethlehem Steel Corp. new complex at Burns Harbor, slabs were brought in by rail from company steelmaking plants in the East and were finished at the newly completed plate mill, cold rolled sheet and tin mill, and hot strip mill. By 1970, the Burns Harbor operation is scheduled to be a fully integrated plant, producing its own steel from raw materials shipped in through the new Port of Indiana, Burns Harbor waterway.

Inland Steel Co. announced plans for a $100 million expansion of its Indiana Harbor Works. Included are the company's first continuous casting and electric furnace facilities and its second basic oxygen steelmaking installation. The casting and electric furnace facilities are scheduled for completion in 1971 and the basic oxygen installation in 1973.

Two of the steel companies are making substantial contributions toward pollution control. Inland Steel Co. completed installation of a $7 million electrostatic precipitator, air-pollution-control facility at its Indiana Harbor plant. Bethlehem Steel Co. announced plans for additional water pollution control facilities costing in excess of

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[5] American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada as of December 31, 1968. V. 23, April 1969, p. 78.

[6] Oil and Gas Journal. U.S. Refineries: Where, Capacities, Types of Processing. V. 67, No. 12, Mar. 24, 1969, pp. 122–123.

Table 14.—Oil and gas wells drilled in 1968

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Adams	-----	-----	-----	-----	-----	1	1
Allen	-----	6	-----	-----	-----	1	7
Cass	-----	-----	-----	-----	-----	1	1
Clay	-----	-----	-----	-----	-----	1	1
Daviess	-----	-----	-----	-----	-----	8	8
Dearborn	-----	-----	-----	-----	-----	1	1
Delaware	-----	1	-----	-----	-----	1	2
Dubois	3	-----	3	1	1	5	13
Gibson	35	-----	13	9	-----	16	73
Grant	2	-----	1	-----	-----	-----	3
Greene	-----	1	-----	-----	-----	-----	1
Hamilton	1	-----	1	-----	-----	-----	2
Harrison	-----	-----	1	-----	-----	1	2
Huntington	1	-----	1	-----	-----	-----	2
Jasper	-----	-----	-----	-----	-----	1	1
Jay	1	-----	-----	-----	-----	2	3
Jefferson	-----	-----	-----	-----	-----	1	1
Knox	10	-----	2	2	-----	10	24
Kosciusko	-----	-----	-----	-----	-----	1	1
Lawrence	-----	-----	-----	-----	-----	1	1
Miami	3	-----	2	-----	-----	3	8
Noble	-----	-----	-----	-----	2	1	3
Perry	-----	-----	-----	-----	-----	3	3
Pike	8	-----	7	-----	-----	9	24
Posey	22	-----	14	3	-----	10	49
Randolph	-----	-----	-----	-----	1	1	2
Shelby	-----	3	-----	-----	-----	-----	3
Spencer	18	-----	15	3	1	21	58
Sullivan	3	1	1	-----	-----	3	8
Vanderburgh	5	-----	1	1	-----	6	13
Vermillion	1	-----	-----	-----	-----	-----	1
Wabash	1	-----	2	-----	-----	14	17
Warrick	1	-----	-----	1	-----	8	10
Washington	-----	-----	-----	-----	-----	1	1
Wells	1	-----	2	-----	-----	-----	3
White	-----	-----	-----	-----	-----	5	5
Total	[1] 116	12	[2] 66	20	5	137	[3] 356

[1] Includes oil wells completed in secondary recovery projects.
[2] Includes dry holes completed in secondary recovery projects.
[3] Includes workovers without newly drilled footages.

Source: Petroleum Section, Indiana Geological Survey.

$8 million at its Burns Harbor plant. These facilities are being added to the existing $24 million waste water treatment system.

Other Metals.—Antimonial lead, bismuth, gold, lead, silver, and tellurium were recovered by United States Smelting Lead Refinery, Inc., at its East Chicago plant in Lake County.

Table 15.—Principal producers[1]

Commodity, company, and plant	Address	Type of activity	County
Abrasive stone: Hindostan Whetstone Co.	Box 501 Bedford, Ind. 47421	Quarry; stationary plant.	Orange.
Cement:			
Lehigh Portland Cement Co.	Young Bldg., 718 Hamilton St. Allentown, Pa. 18105	Portland and masonry, dry process.	Lawrence.
Lone Star Cement Corp.	2511 E. 46th St., Suite "K" Indianapolis, Ind. 46205	Portland and masonry, wet process.	Putnam.
Louisville Cement Co.	501 S. 2nd St. Louisville, Ky. 40202	Portland and masonry, wet and dry process.	Cass and Clark.
Universal Atlas Cement Div. United States Steel Corp.	Chatham Center, Box 2969 Pittsburgh, Pa. 15230	Portland and masonry, dry process.	Lake.
Clays and shale:			
Adams Clay Products Co.	Box 32 Martinsville, Ind. 46151	Pits and plant	Morgan.
American Brick Co.	6558 W. Fullerton Ave. Chicago, Ill. 60635	Pit and plant	Lake.
American Vitrified Products Co.	701 National City Bank Bldg. Cleveland, Ohio 44114	Pits and plants	Clay and Montgomery.
Arketex Ceramic Corp.	Box 347 Brazil, Ind. 47834	Pit and plants	Vermillion.
Bloomfield Shale, Inc.	Box 272 Bloomfield, Ind. 47424	Pit and plant	Greene.
Colonial Brick Corp.	Box 365 Cayuga, Ind. 47928	Pits and plants	Vermillion.
Hydraulic-Press Brick Co.	Box 368 Crawfordsville, Ind. 47933	do	Fountain, Montgomery, Morgan.
The Krick-Tyndall Co., Sub. Hancock Brick & Tile Co.	Box 450 Findlay, Ohio 45840	Pit and plant	Adams.
Lehigh Portland Cement Co.	Young Bldg., 718 Hamilton St. Allentown, Pa. 18105	Pit	Jackson.
Log Cabin Coal Co.	304 S. Depot St. Brazil, Ind. 47834	Pits	Clay.
Louisville Cement Co.	501 S. 2d St. Louisville, Ky. 40202	do	Cass and Clark.
Peabody Coal Co.	301 N. Memorial Dr. St. Louis, Mo. 63102	Pit	Owen.
Coal (bituminous):			
Ayrshire Collieries Corp.:	430 Big Four Bldg. Indianapolis, Ind. 46225		
Chinook		Strip mine; cleaning plant.	Clay.
Ayrcoe		Strip mine	Pike.
Minnehaha		Strip mine; cleaning plant.	Sullivan.
Thunderbird		Underground mine; cleaning plant.	Do.
Wright		Strip mine	Warrick.
Cornell Excavating, Inc.	Route 4 Boonville, Ind. 47601	do	Do.
Enos Coal Corp., Old Ben Coal Corp.:	10 S. Riverside Plaza Chicago, Ill. 60606		
Enos		do	Gibson, Pike, Warrick.
		Cleaning plant	Pike.
Blackfoot No. 5		Strip mine; cleaning plant.	Do.
J. R. Coal Corp.	Route 1 Chandler, Ind. 47610	Strip mine	Warrick.
Kings Station Coal Corp.	10 S. Riverside Plaza Chicago, Ill. 60606	Underground mine; cleaning plant.	Gibson.
Lemmons & Co., Inc.	535 S. 2d St. Boonville, Ind. 47601	Strip mine	Warrick.
Mount Pleasant Mining Corp.	Route 25, Box 19 Terre Haute, Ind. 47801	Underground mine; cleaning plant.	Vigo.
Mulzer Brothers	Box 248 Tell City, Ind. 47586	Strip mine	Spencer.
Parke Coal Co.	Box 236 Petersburg, Ind. 47567	do	Pike.
Peabody Coal Co.:	301 N. Memorial Dr. St. Louis, Mo. 63102		
Hawthorn		Strip mine; cleaning plant.	Greene.
Latta		do	Do.
Old Glory		Strip mine	Do.
Chieftain		Strip mine; cleaning plant.	Vigo.
Dugger		Strip mine	Sullivan.

See footnote at end of table.

Table 15.—Principal producers [1]—Continued

Commodity, company, and plant	Address	Type of activity	County
Coal (bituminous)—Continued			
Peabody Coal Co.—Continued			
Lynnville		Strip mine; cleaning plant.	Warrick.
Squaw Creek		do	Do.
Victoria		Strip mine	Do.
R. S. & K. Coal Corp	Route 2 Shelburn, Ind. 47879	Underground mine	Sullivan.
Coke:			
Citizens Gas & Coke Utility	2020 N. Meridian Indianapolis, Ind. 46209	Coke ovens	Marion.
Indiana Gas & Chemical Corp.	1341 Hulman St. Terre Haute, Ind. 47802	do	Vigo.
Inland Steel Co	3210 Watling St. East Chicago, Ind. 46312	do	Lake.
United States Steel Corp	Gary, Ind. 46400	do	Do.
The Youngstown Sheet & Tube Co.	Box 900 Youngstown, Ohio 44501	do	Do.
Gypsum:			
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	Underground mine; calcining and board plant.	Martin.
United States Gypsum Co	101 S. Wacker Dr. Chicago, Ill. 60606	Underground mine; calcining and board plants.	Lake and Martin.
Iron and steel:			
Inland Steel Co	3210 Watling St. East Chicago, Ind. 46312	Iron blast furnaces and open-hearth steel furnaces.	Lake.
United States Steel Corp. Gary Steel Works	Gary, Ind. 46400	do	Do.
The Youngstown Sheet & Tube Co.	Box 900 Youngstown, Ohio 44501	do	Do.
Lime: Marblehead Lime Co	300 W. Washington St. Chicago, Ill. 60606	Quicklime, 3 rotary kilns.	Do.
Peat:			
Allen's Ideal Products	Box 195 LaPorte, Ind. 46350	Bog; processing plant.	LaPorte.
Glacier Peat Moss Corp	Route 1 Jonesboro, Ind. 46938	do	Grant.
Millburn Peat Co., Inc	Box 297 Otterbein, Ind. 47970	do	Warren.
Peat Moss Co	1981 East 56th St. Indianapolis, Ind. 46204	do	Marion.
Expanded perlite:			
Airlite Processing Corp	P.O. Scottsburg Vienna, Ind. 47170	Processing plant	Scott.
Federal Cement Products, Inc.	24 Marble St. Hammond, Ind. 46320	do	Lake.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	do	Martin.
United States Gypsum Co	101 S. Wacker Dr. Chicago, Ill. 60606	Processing plants	Lake and Martin.
Petroleum refineries:			
American Oil Co	2400 New York Ave. Box 710 Whiting, Ind. 46394		Lake.
Cities Service Oil Co	4900 Cline Ave. Box 718 East Chicago, Ind. 46312		Do.
Mobil Oil Corp	3821 Indianapolis Blvd. East Chicago, Ind. 46312		Do.
Sinclair Refining Co	3500 Indianapolis Blvd. East Chicago, Ind. 46312		Do.
Roofing granules: H. B. Reed & Co., Inc	6937 Kennedy Ave. Hammond, Ind. 46320	2 plants; produced from slag.	Do.
Sand and gravel:			
American Aggregates Corp	Garst Ave. at Ave. B Greenville, Ohio 45331	Pits; stationary plants.	Hamilton, Marion, Wayne.
Paul C. Brudi Stone & Gravel Co., Inc.	Box 2837 Fort Wayne, Ind. 46808	do	Allen and De Kalb.
Crisman Sand Co., Inc	6480 Melton Road Portage, Ind. 46368	Pit; stationary plant	Porter.
Hilltop Concrete Corp	Box 11056 Cincinnati, Ohio 45211	do	Switzerland.
Indiana Glass Sand Corp	Box 614 New Albany, Ind. 47150	do	Harrison.
Interstate Sand & Gravel Co., Inc.	Box 38 Covington, Ind. 47932	do	Warren.

See footnote at end of table.

Table 15.—Principal producers [1]—Continued

Commodity, company, and plant	Address	Type of activity	County
Sand and gravel—Continued			
Irving Bros. Gravel Co., Inc.	Route 3 Marion, Ind. 46952	Pit; stationary plant	Grant.
Irving Materials, Inc., No. 2	Box 369 Greenfield, Ind. 46140	Pits; portable and stationary plants.	Hamilton and Henry.
Kickapoo Sand & Gravel Corp. J. C. O'Connor & Sons, Inc.	Catholic Cemetery Road Peru, Ind. 46970	Pit; stationary plant	Miami.
Knox County Sand Co. Ralph Rogers & Co., Inc.	Box 483 Vincennes, Ind. 47591	Pit; portable and stationary plants.	Knox.
Manley Sand Division Martin Marietta Corp.	110 E. Main St. Rockton, Ill. 61072	Pit; stationary plant	LaPorte.
May Stone & Sand, Inc.	Box 2927 Fort Wayne, Ind. 46809	Pits; stationary plants.	Allen.
Myers Sand & Gravel Corp.	Box 212 Anderson, Ind. 46015	Pit; stationary plant	Madison.
Neal Gravel Co., Inc. Interstate Sand & Gravel Co., Inc.	Box 38 Covington, Ind. 47932	do	Fountain.
Rieth-Riley Const. Co., Inc.	Box 566 Sturgis, Mich. 49091	Pits; portable plants	Elkhart, Lagrange, Noble, St. Joseph.
S & G Excavating, Inc.	Route 1, Box 468 Terre Haute, Ind. 47801	Pit; stationary plants.	Vigo.
Standard Materials Corp. Martin Marietta Corp.	11 N. Penn. St. Indianapolis, Ind. 46204	Pits; portable and stationary plants.	Clark, Hamilton, Marion, Vermillion, Vigo.
Stone-Street Gravel, Inc.	Route 1 Angola, Ind. 46703	Pit; portable and stationary plants.	Steuben.
Sturm & Dillard Gravel Co., Inc.	Box 98 Syracuse, Ind. 46567	Pit; stationary plant	Kosciusko.
Western Indiana Aggregates, Inc.:	500 N. 6th St. Lafayette, Ind. 47901		
Anderson Gravel Division.		do	Madison.
Eagle Materials, Inc.		Dredge; stationary plant.	Lake.
Hanna Sand & Gravel Co., Inc.		do	LaPorte.
Lafayette No. 1 Gravel Division.		Pit; stationary plant	Tippecanoe.
Lafayette Portable Gravel Division.		Pit; portable plant	Do.
Leesburg Gravel Division.		Pit; stationary plant	Kosciusko.
Montezuma Gravel Division.		do	Parke
South Bend Gravel Division.		do	St. Joseph.
Nonferrous smelters and refineries:			
Aluminum Company of America.	Newburgh, Ind. 47630	Aluminum smelter	Warrick.
American Smelting & Refining Co.	2230 Indianapolis Blvd. Whiting, Ind. 46394	Lead secondary plant.	Lake.
National Lead Co. American Lead Plant.	1600 E. 21st St. Indianapolis, Ind. 46218	do	Marion.
United States Smelting Lead Refinery, Inc.	5300 Kennedy Ave. East Chicago, Ind. 46312	Lead primary and secondary plant.	Lake.
Stone:			
Limestone and dolomite:			
American Aggregates Corp.	Garst Ave. at Ave. B Greenville, Ohio 45331	Quarries; stationary plants.	Hamilton and Owen.
Bloomington Crushed Stone Co., Inc.	Box 849 Bloomington, Ind. 47401	do	Lawrence and Monroe.
Bloomington Limestone Corp.	Box 44 Bloomington, Ind. 47401	do	Monroe.
Empire Stone Co.	Box 788 Bloomington, Ind. 47401	do	Lawrence and Monroe.
Erie Stone, Inc. Irving Bros. Gravel Co., Inc.	Route 3 Marion, Ind. 46952	do	Huntington and Wells.
Independent Limestone Co.	Route 5, Box 395 Bloomington, Ind. 47401	Quarry; stationary plant.	Monroe.
Indiana Limestone Co., Inc.	405 N. 1st St. Bedford, Ind. 47421	Quarries; stationary plants.	Lawrence and Monroe.

See footnote at end of table.

Table 15.—Principal producers [1]—Continued

Commodity, company, and plant	Address	Type of activity	County
Stone—Continued			
Limestone and dolomite—Continued			
Lehigh Portland Cement Co.	Young Bldg., 718 Hamilton St. Allentown, Pa. 18105	Quarry; stationary plant.	Lawrence.
Lone Star Cement Corp.	2511 E. 46th St., Suite "K" Indianapolis, Ind. 46205	do	Putnam.
Louisville Cement Co.	501 S. 2d St. Louisville, Ky. 40202	Quarries; stationary plants.	Cass and Clark.
May Stone & Sand, Inc.	Box 2927 Fort Wayne, Ind. 46800	do	Allen.
Midwest Aggregates Corp. Old Fort Industries, Inc.	2013 S. Anthony Blvd. Fort Wayne, Ind. 46803	Quarry; stationary plant.	Do.
Mitchell Crushed Stone Co., Inc. Ralph Rogers & Co., Inc.	Box 849 Bloomington, Ind. 47401	do	Lawrence.
Mulzer Brothers	Box 248 Tell City, Ind. 47586	Quarries, underground mine; stationary plants.	Crawford and Perry.
Newton County Stone Co., Inc. Ralph Rogers & Co., Inc.	Box 147 Kentland, Ind. 47951	Quarry; stationary plant.	Newton.
Ohio & Indiana Stone Corp. The France Stone Co.	1800 Toledo Trust Bldg. Toledo, Ohio 43604	do	Putnam.
Victor Oolitic Stone Co.	Box 668 Bloomington, Ind. 47401	do	Monroe.
Standard Materials Corp. Martin Marietta Corp.	11 N. Penn St. Indianapolis, Ind. 46204	Quarries; stationary plants.	Clark, Floyd, Madison, Putnam.
Texas Quarries, Inc.	Box 64 Bloomington, Ind. 47401	Quarry; stationary plant.	Monroe.
Western Indiana Aggregates, Inc., Francesville Stone Division.	500 N. 6th St. Lafayette, Ind. 47901	do	Pulaski.
Woolery Stone Co., Inc.	Box 40 Bloomington, Ind. 47401	do	Monroe.
Marl:			
Vernon M. Kaufman	Route 1 Topeka, Ind. 46571	Pit	Noble.
Miller Marl	Middlebury, Ind. 46540	Pit	Lagrange.
Phillips Marl Service	Route 2, Box 133 Argos, Ind. 46501	Pit	Marshall.
Willis Speicher	Middlebury, Ind. 46540	Pit	Lagrange.
Taylor and Son	Fremont, Ind. 46737	Pit	Steuben.
Sandstone:			
High Bluff Quarry	Route 3, Box 267 Mooresville, Ind. 46158	Quarry; finishing plant.	Morgan.
Indiana Sandstone Co., Inc.	Box 501 Bedford, Ind. 47421	do	Lawrence.
St. Meinrads Sandstone	St. Meinrads, Ind. 47577	Quarry Finishing plant	Spencer. Dubois.
Springs Valley Sandstone Co.	Route 1 W. Baden Springs, Ind. 47469	Quarries Finishing plant	Lawrence, Martin, Orange. Martin.
Recovered sulfur:			
American Oil Co.	910 S. Michigan Ave. Chicago, Ill. 60680	Mathieson-Fluor process.	Lake.

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[1] Data regarding producers of natural gas and petroleum not available.

The Mineral Industry of Iowa

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Iowa for collecting information on all minerals except fuels.

By Guy A. Johnson [1]

Value of 1968 Iowa mineral production increased nearly 4 percent to $117.3 million, second only to the $119.3 million recorded in 1966. The decreases recorded in sand and gravel and peat production were more than offset by increases in value of all other mineral commodities produced. Increases of over 10 percent occurred in the value of gypsum and lime output. Nonmetals comprised 97 percent of the State total value and fuels 3 percent. No metallic mineral production was reported during the year.

Mineral production was reported from 97 of 99 Iowa counties. There were 15 counties with value of mineral production over $1 million. Cerro Gordo County led the State in mineral output value, and accounted for 23 percent of the total. Polk and Scott Counties, with 14 percent and 13 percent respectively, were second and third. Value of mineral production increased in 46 counties and decreased in 52.

The Iowa Geological Survey published a preliminary interpretation of an airborne magnetometic survey of northeastern Iowa which reported deep magnetometer anomalies.

Table 1.—Mineral production in Iowa [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland .... thousand 376-pound barrels	13,712	$45,394	13,900	$47,275
Masonry .... thousand 280-pound barrels	612	1,853	624	1,986
Clays .... thousand short tons	1,208	1,643	1,264	1,747
Coal (bituminous) .... do	883	3,227	876	3,289
Gypsum .... do	1,219	5,186	1,351	5,838
Sand and gravel .... do	17,734	16,564	16,332	15,192
Stone .... do	26,133	37,912	26,150	40,397
Value of items that cannot be disclosed:				
Other nonmetals and peat	XX	1,443	XX	1,573
Total	XX	113,222	XX	117,297
Total 1957-59 constant dollars	XX	109,576	XX	p 112,494

p Preliminary. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

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[1] Mining engineer, Bureau of Mines, Minneapolis, Minn.

Table 2.—Value of mineral production in Iowa, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Adair	W	W	Stone.
Adams	W	W	Do.
Allamakee	W	$287	Stone, sand and gravel.
Appanoose	$663	757	Stone, clays, coal.
Audubon	147	W	Sand and gravel.
Benton	W	W	Stone, sand and gravel, clays.
Black Hawk	1,520	1,550	Stone, sand and gravel.
Boone	W	267	Sand and gravel, clays.
Bremer	W	W	Stone, sand and gravel.
Buchanan	277	319	Stone.
Buena Vista	217	483	Sand and gravel.
Butler	429	481	Stone, sand and gravel.
Calhoun	42	67	Sand and gravel.
Carroll	184	136	Do.
Cass	W	W	Stone.
Cedar	W	263	Do.
Cerro Gordo	25,631	26,979	Cement, stone, clays, lime, sand and gravel.
Cherokee	383	276	Sand and gravel.
Chickasaw	W	223	Stone, sand and gravel.
Clarke	W	W	Stone.
Clay	198	175	Sand and gravel.
Clayton	689	826	Stone, sand and gravel.
Clinton	W	1,181	Do.
Crawford	195	76	Sand and gravel.
Dallas	650	654	Sand and gravel, clays, stone.
Decatur	647	786	Stone, sand and gravel.
Delaware	300	279	Do.
Des Moines	2,185	2,425	Stone, gypsum, sand and gravel.
Dickinson	W	164	Sand and gravel.
Dubuque	802	782	Stone, sand and gravel.
Emmet	331	272	Sand and gravel.
Fayette	642	587	Stone, sand and gravel.
Floyd	338	285	Stone, clays, sand and gravel.
Franklin	W	375	Sand and gravel, clays, stone.
Fremont	W	W	Stone, sand and gravel.
Greene	227	W	Sand and gravel.
Grundy	W	W	Stone, sand and gravel.
Guthrie	78	74	Sand and gravel.
Hamilton	369	342	Stone, sand and gravel.
Hancock	399	230	Sand and gravel, stone.
Hardin	1,638	1,724	Stone, sand and gravel.
Harrison	1,012	694	Do.
Henry	W	193	Do.
Howard	311	179	Do.
Humboldt	1,130	982	Do.
Ida	W	-------	
Iowa	W	W	Sand and gravel.
Jackson	330	317	Stone, sand and gravel.
Jasper	W	W	Sand and gravel, stone.
Jefferson	W	155	Stone, sand and gravel.
Johnson	1,326	1,577	Do.
Jones	547	662	Do.
Keokuk	W	W	Stone, clays.
Kossuth	328	160	Sand and gravel.
Lee	W	406	Stone, sand and gravel.
Linn	2,523	2,694	Do.
Louisa	W	W	Do.
Lucas	362	W	Coal.
Lyon	W	92	Sand and gravel.
Madison	3,367	3,785	Stone, clays.
Mahaska	1,518	1,423	Coal, stone, sand and gravel, clays.
Marion	1,871	1,911	Coal, stone, sand and gravel.
Marshall	W	1,472	Stone, sand and gravel.
Mills	W	W	Do.
Mitchell	429	280	Do.
Monona	W	W	Sand and gravel.
Monroe	650	W	Coal.
Montgomery	W	W	Stone.
Muscatine	978	959	Sand and gravel, stone.
O'Brien	115	135	Sand and gravel.
Osceola	128	199	Do.
Page	W	W	Stone, sand and gravel.
Palo Alto	132	87	Sand and gravel.
Plymouth	W	371	Do.
Pocahontas	W	W	Stone, sand and gravel.
Polk	17,302	16,728	Cement, sand and gravel, clays.
Pottawattamie	W	W	Stone, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Iowa, by counties [1]—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Poweshiek	W	W	Stone.
Ringgold	-------	W	Do.
Sac	$537	$503	Sand and gravel.
Scott	13,789	15,340	Cement, stone, lime, clays, sand and gravel.
Shelby	237	W	Sand and gravel.
Sioux	607	652	Do.
Story	1,718	858	Sand and gravel, stone, clays.
Tama	W	165	Stone, sand and gravel.
Taylor	W	W	Stone.
Union	W	W	Do.
Van Buren	592	713	Stone, coal, sand and gravel.
Wapello	494	W	Stone, sand and gravel, clays.
Warren	82	W	Sand and gravel, clays.
Washington	W	W	Stone.
Wayne	W	W	Do.
Webster	5,223	5,789	Gypsum, stone, clays, sand and gravel.
Winnebago	W	W	Peat, sand and gravel.
Winneshiek	505	742	Stone, sand and gravel.
Woodbury	W	399	Sand and gravel, clays.
Worth	365	583	Stone, sand and gravel, peat.
Wright	144	145	Sand and gravel.
Undistributed [2]	15,389	12,620	
Total [3]	113,222	117,297	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Davis County is not listed because no production was reported.

[2] Includes some sand and gravel and stone that cannot be assigned to specific counties, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Iowa business activity

	1967	1968	Change (percent)
Employment and labor force, annual average: [1]			
Total labor force ... thousands	[r] 1,199.9	1,214.9	+1.3
Agricultural employment ... do	[r] 196.5	191.8	—2.4
Nonagricultural employment [2] ... do	[r] 973.0	992.1	+2.0
Manufacturing ... do	[r] 218.7	222.0	+1.5
Construction ... do	[r] 41.2	41.0	—.5
Mining ... do	[r] 3.4	3.5	+2.9
Stone, clay, and glass products ... do	[r] 6.5	6.6	+1.5
Primary metal industries ... do	8.7	8.0	—8.0
All other ... do	573.2	592.1	+3.3
Payrolls, manufacturing [3] ... millions	$1,484	$1,607	+8.3
Personal income:			
Total ... do	$8,558	[p] $9,408	+9.9
Per capita	$3,087	[p] $3,391	+9.8
Construction activity:			
Building permits: [4]			
Valuation of authorized residential construction ... millions	[r] $183.4	$173.2	—5.6
Number of private and public residential units authorized	[r] 13,198	11,973	—9.3
Contract construction work performed:			
Total ... millions	[r] $671	$699	+4.2
Nonresidential building ... do	$245	$255	+4.1
Residential building ... do	[r] $261	$262	+.4
Nonbuilding ... do	$165	$183	+10.9
State highway commission contracts awarded [5] ... do	$126.3	$91.9	—27.2
Portland cement shipments to and within Iowa thousand 376-pound barrels	9,035	8,098	—10.4
Retail sales ... millions	$4,698	$5,124	+9.1
Farm marketing receipts ... do	[r] $3,437.5	[p] $3,523.0	+2.5
Mineral production ... do	$113.2	$117.3	+3.6
Utility sales or consumption:			
Production of electric energy by electric utilities million kilowatt-hours	11,196	[p] 12,684	+13.3
Natural gas consumption ... million cubic feet	272,850	297,498	+9.0

[p] Preliminary. [r] Revised.

[1] Adjusted to March 1968 benchmark levels.

[2] Includes nonagricultural wage and salary, self-employed, unpaid family workers, and domestic workers in private households.

[3] Includes workers covered under the Iowa Employment Security Law.

[4] Based on a nationwide survey of 13,000 permit issuing places.

[5] Fiscal year ending June 30.

Sources: Iowa Employment Security Commission in cooperation with the U.S. Department of Labor, Survey of Current Business, Construction Reports, Statistical Abstract of the United States, Iowa State Highway Commission, Sales Management, Farm Income Situation, and Federal Power Commission.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal and peat	207	213	44	376	------	7	18.62	367
Nonmetal	1,045	269	281	2,263	------	52	22.98	573
Sand and gravel	1,073	214	229	2,080	1	40	19.71	3,572
Stone	2,489	265	661	5,704	3	85	15.43	3,712
Total	4,814	252	1,215	10,423	4	184	18.04	2,882
1968:p								
Coal and peat	235	196	46	404	------	9	22.26	445
Nonmetal	705	270	190	1,533	------	53	34.57	907
Sand and gravel	1,040	211	219	2,003	1	34	17.48	3,325
Stone	2,570	272	698	5,971	4	85	14.90	4,388
Total [1]	4,545	254	1,153	9,912	5	181	18.77	3,474

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

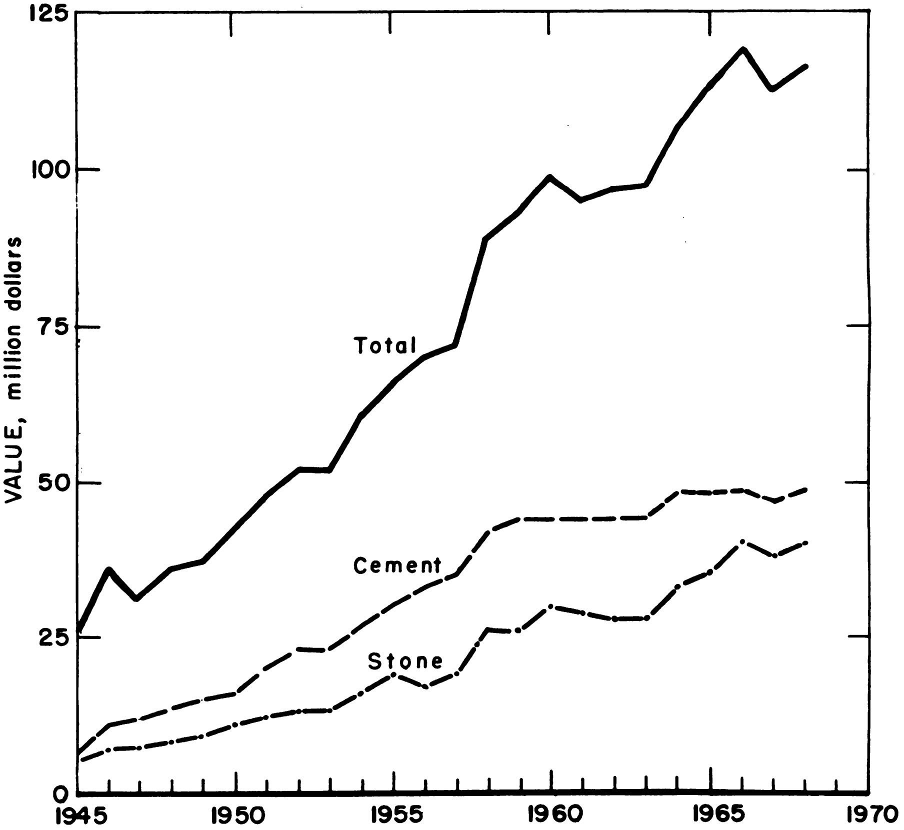

Figure 1.—Value of cement, stone, and total value of mineral production in Iowa.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Iowa shipments of portland cement increased about 1 percent in quantity and 4 percent in value in 1968. Average value per 376-pound barrel, f.o.b. mill, increased from $3.31 to $3.40. Five companies operated 19 kilns, the same number as in 1967.

Types I and II (general use and moderate-heat) cements accounted for about 96 percent of the total Iowa portland cement production; about 14 percent was air-entrained and 86 percent non-air-entrained. Type III (high-early-strength) cement accounted for less than 4 percent of production; 43 percent of the type III output was air-entrained and 57 percent non-air-entrained. Three companies used a wet process to manufacture their product, while the other two employed a dry process. Electrical energy consumed in portland cement production totaled 326.9 million kilowatt-hours, an increase of 2 percent from that of 1967. About 83 percent of the power was purchased, and 17 percent was home generated. About 85 percent of Iowa's portland cement was shipped to consumers in Iowa and Minnesota. Other States, listed in order of destination of shipments, were Wisconsin, Illinois, North Dakota, Nebraska, South Dakota, and Missouri. Truck transportation moved 55 percent of the material, while railroads carried 45 percent. Of the total shipments, 93 percent was in bulk form and the other 7 percent in bags. Approximately 65 percent of the State total portland cement shipments went to ready-mixed concrete companies, 17 percent to concrete product manufacturers, 10 percent to highway contractors, 5 percent to building material dealers, and the remainder to other consumers, including other contractors and Federal, State, and local governments. Over 1.9 million barrels of portland cement were shipped into Iowa, principally from plants in Illinois, Missouri, and Nebraska.

Raw materials utilized in the manufacture of portland cement in Iowa included over 3.7 million tons of cement rock and limestone, 654,000 tons of clay and shale, and 126,000 tons of gypsum. Small quantities of such items as mill scale, iron ore, and blast furnace slag were also consumed.

Masonry cement was produced at all cement plants in the State except the Penn-Dixie Cement Corp. plant in Polk County. Shipments increased 2 percent in quantity and 7 percent in value. Average value per 280-pound barrel, f.o.b. mill, increased from $3.03 to $3.18. Minnesota continued as the largest consumer of Iowa's masonry cement, receiving over 52 percent of the total shipments. Iowa consumed over 25 percent of its product, while Illinois, Wisconsin, and North Dakota received the majority of the rest. Other States receiving shipments were South Dakota, Nebraska, and Missouri. Over 34,000 barrels of masonry cement was shipped into Iowa.

Clays.—Total production of clay and shale increased 5 percent in quantity and 6 percent in value. Major increases were recorded in the use of clays for manufacturing vitrified sewerpipe, building brick, and cement. Decreases were reported in the use of clay for manufacturing other heavy clay products and lightweight aggregate.

Twenty-six pits were operated by 25 companies in 17 counties during the year. The manufacture of cement required about 50 percent of the output, while heavy clay products utilized about 43 percent. The remainder was used in manufacturing lightweight aggregate and mortar mix. No fire clay production was recorded in Iowa in 1968.

The Adel Clay Products Co. discontinued operations at its Appanoose County property. The Ottumwa Brick & Tile Co. purchased the Nelson Clay Pit in Keokuk County from Oskaloosa Clay Products Co. Garrison Brick & Tile Works sold its operations at Garrison in Benton County to Edward Vinson of Keystone, Iowa.

Gypsum.—Iowa ranked third in the United States in the quantity of crude gypsum produced in 1968. State production increased over 10 percent, and value rose over 12 percent. Gypsum was produced from an underground mine operated by the United States Gypsum Co., in Des Moines County, and from four open-pit mines operated in Webster County by The Celotex Corp., Georgia-Pacific Corp., National Gypsum Co., and United States Gypsum Co. All producing companies operated calcining plants utilizing natural gas as fuel.

Uncalcined gypsum was sold for use as portland-cement retarder, agricultural use, brewer's fixe, filler, and other uses. Calcined gypsum was sold for such building purposes as base-coat plasters, veneer plaster, mill-mixed basecoats, gaging and molding plasters, prepared finishes, roof-deck plasters, lath, wallboard, sheathing, laminated board, and formboard for poured-in-place gypsum roof deck. Calcined gypsum was also sold for use in industrial manufacturing such as plate glass and terra cotta; dental and orthopedic plaster; and industrial molding, art, and casting plasters.

Lime.—Total production of quicklime and hydrated lime increased 27 percent in quantity and 15 percent in value. Increased usage in construction, mostly for soil stabilization, and for chemical and industrial purposes accounted for the substantial gain in output. Over 50 percent of Iowa's output was used in steelmaking, while water purification, sugar refining, paper and pulp, and calcium carbide manufacture also consumed significant amounts. Markets for State-produced lime were principally in Iowa, Illinois, and Indiana. Other consuming States, in decreasing order of shipments received, were Wisconsin, Nebraska, Michigan, Minnesota, Missouri, and Kansas. About 58,000 tons of lime was shipped to Iowa from other States, mostly from Missouri and Illinois.

American Crystal Sugar Co. produced quicklime for internal use in sugar refining at its Mason City plant in Cerro Gordo County. Purchased high-calcium limestone was burned in the company's shaft kiln with coke as fuel. Linwood Stone Products

Table 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commerical operations:				
Sand:				
Building	3,030	$2,966	2,995	$3,090
Paving	2,828	2,852	2,606	2,618
Fill	1,147	736	1,216	768
Other [1]	114	320	145	377
Total	7,119	6,874	6,962	6,853
Gravel:				
Building	1,361	2,289	1,263	2,180
Paving	6,699	5,778	5,600	4,569
Railroad ballast	44	36	(2)	(2)
Fill	164	103	[2] 193	[2] 144
Other	18	15	--------	--------
Total	8,286	8,221	7,056	6,893
Total sand and gravel	15,405	15,095	14,018	13,746
Government-and-contractor operations:				
Sand:				
Building	3	1	1	(3)
Paving	72	40	85	49
Fill	3	1	41	20
Other	2	1	4	1
Total	80	43	131	70
Gravel:				
Paving	2,249	1,426	2,182	1,376
Other	------	--------	1	(3)
Total	2,249	1,426	2,183	1,376
Total sand and gravel	2,329	1,469	2,314	1,446
All operations:				
Sand	7,199	6,917	7,093	6,923
Gravel	10,535	9,647	9,239	8,269
Total	17,734	16,564	16,332	15,192

[1] Includes blast, filtration, molding, railroad ballast, and other construction uses.
[2] Railroad ballast and fill combined to avoid disclosing individual company confidential data.
[3] Less than ½ unit.

Co., Inc., produced quicklime and hydrated lime for commercial purposes at its plant near Buffalo in Scott County. Three rotary kilns, using coal and natural gas as fuel, were used for burning the high-calcium limestone obtained from the company's nearby quarry.

Perlite.—Crude perlite mined outside Iowa was processed (expanded) at the four gypsum plants in Webster County. The expanded product was used principally in the manufacture of lightweight building plaster.

Sand and Gravel.—Iowa sand and gravel production decreased 8 percent in quantity and value from that of 1967. The major cause of the decline was a decrease in the utilization of sand and gravel in paving, which accounted for nearly two-thirds of all sand and gravel used in Iowa. The second major user of sand and gravel, the building industry, also reduced its 1968 requirements. Demand for fill, the third largest use, increased, but this only slightly affected the total picture. A small amount of unground industrial sand was used for molding and sand blasting. Production was reported from 79 counties. Polk County was the leading producer followed by Buena Vista, Sioux, Black Hawk, and Woodbury Counties. The five counties accounted for about 30 percent of the State output. The average value of sand and gravel, which has remained approximately the same since 1965, was $0.93 per ton.

As in 1967, over 97 percent of the commercial sand and gravel output was transported by truck, about 2 percent moved by rail and the remainder by water.

Stone.—Production of stone, consisting entirely of limestone and dolomite, increased slightly in quantity, but value of production increased over 6 percent. The average value for crushed and broken stone rose from $1.44 per ton in 1967 to $1.54 in 1968.

Over 71 percent of the material produced was used in concrete aggregate and roadstone. A more detailed breakdown of aggregate and roadstone usage in 1968 is presented in table 6. Use in manufacture of cement amounted to another 14 percent,

Table 6.—Limestone and dolomite sold or used by producers, by uses

Use	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough construction (rubble)........thousand short tons..	3	$25	3	$28
Dressed architectural:				
Cut..........................thousand cubic feet..	68	128	10	41
House stone veneer..........................do....	26	68	26	64
Sawed..........................do....	6	22	------	--------
Dressed construction..........................do....	------	--------	78	96
Flagging..........................do....	5	6	8	10
Total dimension...approximate thousand short tons..	12	249	11	239
Crushed and broken:				
Concrete aggregate and roadstone:				
Concrete aggregate............thousand short tons..	NA	NA	2,828	5,224
Bituminous aggregate..........................do....	NA	NA	2,025	3,186
Macadam aggregates..........................do....	NA	NA	361	536
Dense graded road base stone..........................do....	NA	NA	4,988	7,204
Surface treatment aggregates..........................do....	NA	NA	8,454	12,202
Total aggregate and roadstone [1]..........................do....	19,119	27,024	18,655	28,352
Agricultural limestone..........................do....	2,488	4,421	2,544	4,508
Cement..........................do....	3,664	4,295	3,737	4,538
Railroad ballast..........................do....	169	173	192	170
Riprap and jetty stone..........................do....	387	450	450	833
Other [2]..........................do....	295	1,299	561	1,756
Total crushed and broken [1]..........................do....	26,120	37,663	26,139	40,158
Grand total [1]..........................do....	26,133	37,912	26,150	40,397

NA Not available.

[1] Data may not add to totals shown because of independent rounding.

[2] Includes stone used for mine dusting (1967); asphalt filler and other fillers or extenders; flux; lime; poultry grit and mineral food; other and unspecified uses.

Table 7.—Production of sand and gravel and stone in 1968, by counties

(Thousand short tons and thousand dollars)

County	Sand and gravel		Stone	
	Quantity	Value	Quantity	Value
Adair	-----	-----	W	W
Adams	-----	-----	W	W
Allamakee	W	W	218	W
Appanoose	-----	-----	331	W
Audubon	W	W	-----	-----
Benton	W	W	W	W
Black Hawk	586	$563	652	$987
Boone	291	W	-----	-----
Bremer	W	W	W	W
Buchanan	-----	-----	249	319
Buena Vista	670	483	-----	-----
Butler	115	117	282	364
Calhoun	104	67	-----	-----
Carroll	176	136	-----	-----
Cass	-----	-----	W	W
Cedar	-----	-----	187	263
Cerro Gordo	120	142	1,901	1,998
Cherokee	272	276	-----	-----
Chickasaw	17	W	W	W
Clarke	-----	-----	W	W
Clay	229	175	-----	-----
Clayton	154	W	317	W
Clinton	235	203	674	978
Crawford	55	76	-----	-----
Dallas	490	486	W	W
Decatur	72	W	W	W
Delaware	W	W	204	W
Des Moines	207	W	W	W
Dickinson	216	164	-----	-----
Dubuque	W	W	551	W
Emmet	292	272	-----	-----
Fayette	54	W	419	W
Floyd	W	W	W	W
Franklin	W	W	38	58
Fremont	12	17	W	W
Greene	189	W	-----	-----
Grundy	20	W	57	109
Guthrie	99	74	-----	-----
Hamilton	164	W	W	W
Hancock	263	W	W	W
Hardin	453	W	W	W
Harrison	186	W	300	W
Henry	79	88	105	105
Howard	26	W	110	W
Humboldt	W	W	765	W
Iowa	W	W	-----	-----
Jackson	67	W	193	W
Jasper	W	W	W	W
Jefferson	1	1	100	154
Johnson	W	W	778	W
Jones	37	$44	337	$618
Keokuk	-----	-----	W	W
Kossuth	226	160	-----	-----
Lee	34	25	239	381
Linn	416	496	1,617	2,198
Louisa	W	W	W	W
Lyon	151	92	-----	-----
Madison	-----	-----	2,180	W
Mahaska	124	129	W	W
Marion	202	218	465	688
Marshall	223	W	W	W
Mills	66	90	W	W
Mitchell	44	30	236	250
Monona	174	W	-----	-----
Montgomery	-----	-----	W	W
Muscatine	550	W	W	W
O'Brien	239	135	-----	-----
Osceola	259	199	-----	-----
Page	W	W	W	W
Palo Alto	137	87	-----	-----
Plymouth	465	371	W	W
Pocahontas	63	41	W	W
Polk	2,040	W	-----	-----
Pottawattamie	23	28	W	W
Poweshiek	-----	-----	W	W
Ringgold	-----	-----	W	W
Sac	561	503	-----	-----
Scott	W	W	2,018	W
Shelby	W	W	-----	-----
Sioux	660	652	-----	-----
Story	463	474	229	W
Tama	42	W	W	W
Taylor	-----	-----	W	W
Union	-----	-----	W	W
Van Buren	W	W	403	W
Wapello	W	W	W	W
Warren	W	W	-----	-----
Washington	-----	-----	W	W
Wayne	-----	-----	W	W
Webster	225	113	368	648
Winnebago	147	82	-----	-----
Winneshiek	141	173	412	569
Woodbury	578	354	-----	-----
Worth	230	W	252	394
Wright	218	145	-----	-----
Undistributed [1]	1,680	7,211	8,965	29,317
Total [2]	16,332	15,192	26,150	40,397

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes production for which no county breakdown is available, and data indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

while agricultural use required almost 10 percent of the stone produced.

Production was reported from 67 counties. Counties from which over 1 million tons of stone was produced were Madison, Scott, Cerro Gordo, and Linn, in descending order of output. About 50 percent of production came from the 10 largest companies in the State.

Iowa's crushed and broken stone industry utilized truck transportation to a vast extent. Over 97 percent moved by truck, over 2 percent moved by rail, and a small fraction of the product was shipped by water.

The agricultural limestone industry has reacted to meet new product specifications now that Iowa is the first State to enact into law evaluation of agricultural lime on an Effective Calcium Carbonate Equivalent (ECCE) basis. The method of evaluation was initiated in 1965 by the Iowa State University in cooperation with the Iowa Limestone Producers Association. The ECCE is a measure of the effectiveness of a given quantity of lime generally expressed as "Certified ____________ pounds ECCE, per ton."

Dimension limestone was produced in only two counties. The Wm. Becker & Sons Stone Co. operated two quarries in Dubuque County, and the Wm. C. Weber Stone Co. operated a quarry in Jones County. The State dimension stone production decreased 10 percent in quantity and 4 percent in value in 1968.

MINERAL FUELS

Coal (Bituminous).—Production of bituminous coal decreased about 1 percent in quantity. However, value of output increased 2 percent, because the value per ton increased from $3.66 in 1967 to $3.75.

Strip mines accounted for approximately two-thirds of Iowa's coal production, while underground mining produced the remainder. A new strip mine was opened by the Mich Coal Co. in Marion County. Three strip mines closed during the year, including the Mich Coal Co. No. 2 and No. 3 mines in Mahaska County, and the Otley Coal Co. No. 2 mine in Marion County.

The same modes of transportation were utilized in 1968 as those in 1967. About 70 percent of the coal was shipped by rail and 30 percent by truck. The major use of coal was in electric utilities. About 69 percent of the 5.5 million tons of coal consumed in Iowa in 1968 was supplied from Illinois mines. Over 14 percent was furnished from mines within the State.

Thickness of underground coal seams mined during the year ranged from 32 inches to 66 inches. Thickness of strip coal seams ranged from 36 inches to 60 inches. Overburden thickness in the strip mines ranged between 35 feet and 50 feet. No mechanical cleaning plants were operated in 1968.

Peat.—The quantity of peat produced in 1968 decreased 15 percent from that of 1967. Value of output decreased 14 percent. The Eli Colby Co. mined moss peat in Winnebago County, near Lake Mills and processed the material at its plant in Hanlontown. The Colby Pioneer Peat Co. mined reed-sedge peat from a deposit near Fertile, in Worth County and opened a new bog near Joice, in the same county. The company also operated a processing plant in Hanlontown. Peat was sold for general soil improvement; as an ingredient for packing flowers, plants, and shrubs; and as an ingredient for potting soils.

Petroleum, Natural Gas.—No production of petroleum or natural gas was reported in Iowa in 1968 nor was any oil exploration drilling conducted.

METALS

Ferroalloys.—The Kemco Division of Foote Mineral Co. produced ferrosilicon and silvery iron at its Keokuk plant, utilizing electric furnaces. The company was the sole producer of ferroalloys in the State.

Table 8.—Coal (bituminous) production in 1968, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines operated		Production (short tons)			Value (thousands)
	Underground	Strip	Underground	Strip	Total	
Appanoose	1	---------	3,725	---------	3,725	W
Lucas	1	---------	119,360	---------	119,360	W
Mahaska	---------	7	---------	300,672	300,672	$1,093
Marion	---------	4	---------	269,486	269,486	1,005
Monroe	1	---------	169,564	---------	169,564	W
Van Buren	---------	1	---------	13,528	13,528	69
Total	3	12	292,649	583,686	876,335	3,289

W Withheld to avoid disclosing individual company confidential data; included with "Total."

Table 9.—Shipments of bituminous coal for consumption in Iowa, by district of origin and consumer use[1]

(Thousand short tons)

Use	District of origin[2]									Total
	7 and 8	9	10	11	12	15	17	19	20	
1964:										
Electric utilities	-----	-----	1,397	1	747	174	-----	-----	-----	2,319
Retail dealers	193	162	132	9	4	40	7	-----	1	548
All others	59	32	1,510	93	261	27	-----	-----	-----	1,982
Total	252	194	3,039	103	1,012	241	7	-----	1	4,849
1965:										
Electric utilities	-----	54	1,593	-----	724	392	-----	-----	-----	2,763
Retail dealers	207	181	124	10	2	34	7	-----	1	566
All others	89	47	1,672	60	272	39	-----	-----	-----	2,179
Total	296	282	3,389	70	998	465	7	-----	1	5,508
1966:										
Electric utilities	-----	179	1,653	-----	731	352	-----	-----	-----	2,915
Retail dealers	185	127	98	4	1	21	6	-----	-----	442
All others	97	67	1,577	29	260	53	-----	-----	-----	2,083
Total	282	373	3,328	33	992	426	6	-----	-----	5,440
1967:										
Electric utilities	-----	225	1,950	-----	683	369	-----	-----	-----	3,227
Retail dealers	133	136	75	-----	-----	5	6	-----	-----	355
All others	67	58	1,544	77	191	30	-----	-----	-----	1,967
Total	200	419	3,569	77	874	404	6	-----	-----	5,549
1968:										
Electric utilities	-----	W	2,240	-----	666	W	-----	17	-----	3,426
Retail dealers	112	W	56	-----	-----	W	6	-----	-----	263
All others	56	W	1,485	29	124	W	-----	-----	-----	1,788
Total	168	418	3,781	29	790	268	6	17	-----	5,477

W Withheld to avoid disclosing individual company confidential data; included with "Total."

[1] Data are based on voluntary reports submitted on separate distribution survey and may not agree with data derived from mine production survey.

[2] States or portion of States represented by each district are as follows: District 7 and 8—eastern Kentucky, southwestern Virginia, southern West Virginia, and north central Tennessee; 9—western Kentucky; 10—Illinois; 11—Indiana; 12—Iowa; 15—Kansas, Missouri, and northeastern Oklahoma; 17—western Colorado and northeastern New Mexico; 19—Wyoming and Idaho; 20—Utah.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Dewey Portland Cement Co., Martin Marietta Corp.	Box 4288, 802 Kahl Bldg. Davenport, Iowa 52800.	Portland and masonry, wet process.	Scott.
Lehigh Portland Cement Co.	Young Bldg., 718 Hamilton St. Allentown, Pa. 18105	Portland and masonry, dry process.	Cerro Gordo.
Marquette Cement Mfg. Co.	20 North Wacker Dr. Chicago, Ill. 60606.	Portland and masonry, wet process.	Polk.
Northwestern States Portland Cement Co.	Box 1008, 12-2d St. NE. Mason City, Iowa 50401.	Portland and masonry, dry process.	Cerro Gordo.
Penn-Dixie Cement Corp.	Box 152 Nazareth, Pa. 18064	Portland, wet process	Polk.
Clays and shale:			
Adel Clay Products Co.	Redfield, Iowa 50233	Pit and plant	Dallas.
Ballou Brick Co.	Sergeant Bluff, Iowa 51054	do	Woodbury.
Carter-Waters Corp.	2440 Pennway Kansas City, Mo. 64100.	do	Appanoose.
Des Moines Clay Co.	4400 North Harding Road Des Moines, Iowa 50313.	do	Polk.
Dewey Portland Cement Co., Martin Marietta Corp.	Box 4288, 802 Kahl Bldg. Davenport, Iowa 52800	Pit	Scott.
W.S. Dickey Clay Mfg. Co.	1818 Commerce Tower Kansas City, Mo. 64105	Pit and plant	Webster.
Iowa Clay Pipe Co.	Box 3510 Des Moines, Iowa 50300	do	Polk.
Kalo Brick & Tile Co.	1230 East First Ave. South Fort Dodge, Iowa 50501	do	Webster.
Lehigh Portland Cement Co.	Young Bldg., 718 Hamilton St. Allentown, Pa. 18105	Pit	Cerro Gordo.
Mason City Brick & Tile Co.	Box 619 Mason City, Iowa 50401	Pit and plant	Do.
Northwestern States Portland Cement Co.	Box 1008, 12-2d St. NE. Mason City, Iowa 50401	Pit	Do.
Ottumwa Brick & Tile Co.	Box 352 Ottumwa, Iowa 52501	Pit Pit and plant	Keokuk. Wapello.
Redfield Brick & Tile Co.	Redfield, Iowa 50233	do	Dallas.
Rockford Brick & Tile Co.	Rockford, Iowa 50468	do	Floyd.
Sheffield Brick & Tile Co.	Sheffield, Iowa 50475	do	Franklin.
United Brick & Tile Co. of Iowa	209 Benson Bldg. Sioux City, Iowa 51102	do	Dallas.
Coal (bituminous):			
Beard Coal Co.	Route 2 Knoxville, Iowa 50138	Strip mine	Marion.
Big Ben Coal Co.	Route 3 Chariton, Iowa 50049	Underground mine	Lucas.
Jude Coal Co., Inc.	Box 265 Bussey, Iowa 50044	Strip mine	Mahaska.
Lovilia Coal Co.	Route 2 Melrose, Iowa 52569	Underground mine	Monroe.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal (bituminous)—Continued			
Mich Coal Co.	Box 16 Oskaloosa, Iowa 52577	4 strip mines	Mahaska, Marion.
Weldon Coal Co.	Harvey, Iowa 50119	2 strip mines	Marion.
Ferroalloys:			
Foote Mineral Co.	320 Concert St. Keokuk, Iowa 52632	Electric furnace	Lee.
Gypsum:			
The Celotex Corp.	1500 North Dale Mabry Tampa, Fla. 33607	Open-pit mine, and calcining and board plants.	Webster.
Georgia-Pacific Corp., Gypsum Division	Box 311 Portland, Oreg. 97207	do	Do.
National Gypsum Co.	325 Delaware Ave. Buffalo, N.Y. 14202	do	Do.
United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	do Underground mine, and calcining and board plant	Do. Des Moines.
Lime:			
American Crystal Sugar Co.	Boston Bldg. Denver, Colo. 80201	Quicklime, shaft kiln	Cerro Gordo.
Linwood Stone Products Co., Inc.	Route 2 Davenport, Iowa 52804	Quicklime and hydrated lime, 3 rotary kilns.	Scott.
Peat:			
Eli Colby Co.	Box 248 Lake Mills, Iowa 50450	Bog, processing plant	Winnebago, Worth.
Colby Pioneer Peat Co.	Box 8 Hanlontown, Iowa 50444	Bog, processing plant	Worth.
Expanded perlite:			
The Celotex Corp.	1500 North Dale Mabry Tampa, Fla. 33607	Processing plant	Webster.
Georgia-Pacific Corp., Gypsum Division	Box 311 Portland, Oreg. 97207	do	Do.
National Gypsum Co.	325 Delaware Ave. Buffalo, N.Y. 14202	do	Do.
United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	do	Do.
Sand and gravel:			
Acme Fuel & Material Co. (W.G.Block Co.)	Box 34 Muscatine, Iowa 52761	Dredges; stationary plants	Muscatine.
Adel Sand & Gravel Co.	Box 128 Adel, Iowa 50003	Pits; portable and stationary plants.	Dallas.
Concrete Materials Division, Martin Marietta Corp.	4096 First Ave. NE. Cedar Rapids, Iowa 52401	Pits, underground mine; portable and stationary plants.	Black Hawk, Clayton, Linn, Mahaska, Marshall, Polk, Wapello, Worth.
Elmer Dole Co.	Irvington, Iowa 50550	Pits; portable plants	Kossuth.

G.A. Finley, Inc	Harlan, Iowa 51537	Pits; portable and stationary plants.	Audubon, Crawford, Pottawattamie, Shelby.
Hallett Construction Co	Crosby, Minn. 56441	do	Boone, Buena Vista Cherokee, Decatur, Franklin, Iowa, Mahaska, Marshall, Osceola, Page, Polk, Sac, Story, Winnebago.
Higman Sand & Gravel Co	Akron, Iowa 51001	Pits, dredge; portable and stationary plants.	Plymouth.
Hogan Construction Co	Rock Rapids, Iowa 51246	Pits; portable plants	Cherokee, Dickinson, Lyon, O'Brien, Plymouth.
Hymans Construction Co., Inc	Hull, Iowa 51239	do	O'Brien, Osceola, Sac, Sioux.
LaHarv Construction Co	Box 173 Forest City, Iowa 50436	do	Hancock, Winnebago.
Maudlin Construction Co	Box 134 Webster City, Iowa 50595	do	Boone, Buena Vista, Butler, Cherokee, Clay, Dickinson, Franklin, Grundy, Hamilton, Hardin, Harrison, O'Brien, Osceola, Plymouth, Polk, Sac, Story, Webster, Woodbury, Worth, Wright.
Midwest Paving Co	219 Benson Bldg. Sioux City, Iowa 51101	Pit; portable plant	Woodbury.
Peters Construction Co	5225 East University Des Moines, Iowa 50317	Pits; portable plants	Monona, Polk.
Pound Construction Co., Inc	Box 217 Scranton, Iowa 51462	do	Carroll, Dallas, Greene, Webster.
Raid Quarries Corp	Farmers & Merchants Bank Bldg., Box 1085 Burlington, Iowa 52601	Pits; portable and stationary plants.	Des Moines, Henry, Jefferson.
Stevens Sand & Gravel Co., Inc	Route 4 Iowa City, Iowa 52240	Dredge; portable plant	Johnson.
VanDusseldorp Sand & Gravel, Inc	Box 156 Colfax, Iowa 50054	Dredge; stationary plant	Jasper.
Welp & McCarten, Inc	522 South 22d St., Box W Fort Dodge, Iowa 50501	Pits; portable plants	Hamilton, Hancock, Webster, Winnebago.
West Des Moines Sand Co	Box 98 West Des Moines, Iowa 50265	Pits, stationary plant	Polk.
White Materials Corp	SE. 36th & Carlisle Road Des Moines, Iowa 50317	Dredge; stationary plant	Do.
Stone: Limestone and dolomite:			
B.L. Anderson, Inc	327 Guaranty Bldg. Cedar Rapids, Iowa 52400	Quarries; portable plants	Linn, Jones.
Concrete Materials Division, Martin Mariette Corp.	4096 First Ave. NE. Cedar Rapids, Iowa 52401	Quarries; portable and stationary plants.	Black Hawk, Chickasaw, Johnson, Linn, Madison, Marshall, Ringgold, Tama, Worth.
DeWees-Potthoff Stone Co	Box 39 Marion, Iowa 52302	Quarries; portable plants	Black Hawk, Cedar, Dubuque, Jones, Linn.
Douds Stone, Inc	611 Church St., Box 187 Ottumwa, Iowa 52501	Quarries, underground mine; portable and stationary plants.	Van Buren, Wapello.
Gendler Stone Products Co	1075 Polk Blvd. Des Moines, Iowa 50311	Quarries; portable plants	Dallas, Madison, Page, Taylor.
Kaser Construction Co	3111 Ingersoll Des Moines, Iowa 50312	do	Des Moines, Fremont, Jasper, Keokuk, Mahaska, Mills, Montgomery, Poweshiek, Washington.
Lehigh Portland Cement Co	Young Bldg., 718 Hamilton St. Allentown, Pa. 18105	Quarry; stationary plant	Cerro Gordo.
Linwood Stone Products Co., Inc. (McCarthy Improvement Co.).	Route 2 Davenport, Iowa 52804	Underground mine and stationary plant.	Scott.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone: Limestone and dolomite—Continued			
Lowe & Eschman Construction Co	3d Ave. & 35th St. Marion, Iowa 52302	Quarries; portable plants	Clinton.
Marquette Cement Mfg. Co	20 North Wacker Dr. Chicago, Ill. 60606	Quarry; stationary plant	Madison.
Paul Niemann Construction Co	Box 38 Sumner, Iowa 50674	Quarries; portable plants	Bremer, Buchanan, Butler, Clayton, Fayette.
Northwestern States Portland Cement Co	Box 1008, 12-2d St., NE. Mason City, Iowa 50401	Quarry; stationary plant	Cerro Gordo.
P & M Stone Co., Inc	Box 569 Humboldt, Iowa 50548	Quarries; portable plants	Cerro Gordo, Humboldt.
Penn-Dixie Cement Corp	Box 152 Nazareth, Pa. 18064	Quarry; stationary plant	Madison.
Raid Quarries Corp	217 Farmers & Merchants Bank Bldg., Box 1085 Burlington, Iowa 52601	Quarries; portable and stationary plants.	Des Moines, Henry, Jefferson, Lee, Van Buren.
The River Products Co	220 Savings & Loan Bldg. Iowa City, Iowa 52240	Quarries, underground mines; portable and stationary plants.	Johnson, Louisa, Washington.
E. I. Sargent Quarries, Inc	2525 West Euclid St. Des Moines, Iowa 50310	Quarries; portable plants	Clarke, Decatur, Madison.
Schildberg Construction Co., Inc	Box 358 Greenfield, Iowa 50849	do	Adair, Adams, Cass, Madison, Union.
Schildberg Rock Products Co., Inc	do	do	Adams, Pottawattamie.
Weaver Construction Co	Box 817 Iowa Falls, Iowa 50126	Quarries; portable and stationary plants.	Cedar, Cerro Gordo, Franklin, Hamilton, Hardin, Jackson, Scott, Story.
Welp & McCarten, Inc	522 South 22d St., Box W Fort Dodge, Iowa 50501	do	Allamakee, Black Hawk, Cerro Gordo, Hancock, Howard, Humboldt, Mitchell, Worth.

The Mineral Industry of Kansas

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the State Geological Survey of Kansas for collecting information on all minerals except fuels.

By George T. McIntyre [1] and A. L. Hornbaker [2]

The value of Kansas mineral production in 1968 was 1 percent below the record high of 1967, due to a decline in oil and gas output. Production value of most other commodities increased. Principal mineral commodities produced were petroleum, natural gas, helium, natural gas liquids, cement, and stone. Mineral fuels and related products comprised 85.3 percent of the total mineral value, nonmetals 14.5 percent, and metals 0.2 percent. Kansas ranked seventh among the States in oil production, fifth in natural gas production, and sixth in natural gas liquids production.

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[1] Petroleum engineer, Bureau of Mines, Bartlesville, Okla.

[2] Geologist, State Geological Survey of Kansas, University of Kansas, Lawrence, Kans.

Table 1.—Mineral production in Kansas[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Portland cement____thousand 376-pound barrels__	8,833	$25,545	9,680	$29,898
Masonry cement____thousand 280-pound barrels__	350	1,000	383	1,177
Clays____thousand short tons__	935	1,339	932	1,433
Coal (bituminous)____do____	1,136	5,294	1,268	6,526
Helium:				
Grade A____thousand cubic feet__	225,000	5,364	291,700	7,300
Crude____do____	2,719,700	32,554	2,749,700	33,600
Lead (recoverable content of ores, etc.)____short tons__	1,031	289	1,227	324
Natural gas____million cubic feet__	871,971	116,844	835,555	115,307
Natural gas liquids:				
Natural gasoline____thousand 42-gallon barrels__	4,623	10,703	4,824	10,977
LP gases____do____	15,835	31,923	15,748	25,827
Petroleum (crude)____do____	99,200	297,600	94,505	285,405
Pumice____thousand short tons__	W	W	11	10
Salt [2]____do____	1,069	14,686	1,128	15,520
Sand and gravel____do____	12,066	8,650	12,427	10,559
Stone____do____	13,551	17,806	14,402	20,714
Zinc (recoverable content of ores, etc.)____short tons__	4,765	1,319	3,012	813
Value of items that cannot be disclosed: Natural cement, gypsum, lime (1968), salt (brine), and value indicated by symbol W____	XX	3,152	XX	3,311
Total____	XX	574,068	XX	568,701
Total 1957–59 constant dollars____	XX	553,887	XX	[p] 545,938

[p] Preliminary. XX Not applicable.

W Withheld to avoid disclosing individual company confidential data; included in "Value of items that cannot be disclosed."

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes salt in brine included with "Value of items that cannot be disclosed."

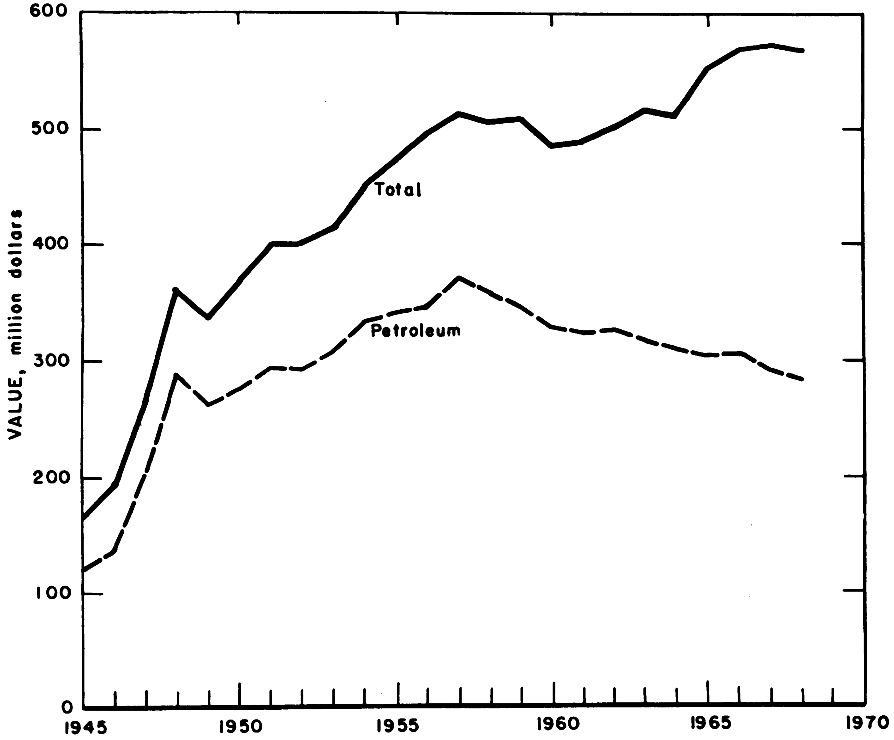

Figure 1.—Value of petroleum, and total value of mineral production in Kansas.

Table 2.—Value of mineral production in Kansas, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Allen	$12,434	$13,629	Cement, petroleum, stone, clays, natural gas.
Anderson	874	765	Petroleum, stone.
Atchison	514	305	Stone.
Barber	9,399	8,508	Natural gas, petroleum, gypsum, natural gas liquids, sand and gravel.
Barton	19,088	17,460	Petroleum, salt, natural gas, sand and gravel, clays.
Bourbon	778	784	Stone, petroleum, cement.
Brown	3	25	Petroleum, sand and gravel.
Butler	14,226	13,557	Petroleum, stone, sand and gravel, natural gas.
Chase	223	250	Stone, sand and gravel, petroleum.
Chautauqua	2,144	1,970	Petroleum, stone, natural gas.
Cherokee	5,937	6,517	Coal, zinc, lead, clays, stone, sand and gravel.
Cheyenne	W	W	Sand and gravel.
Clark	2,670	1,630	Natural gas, petroleum, sand and gravel.
Clay	224	107	Sand and gravel, stone, petroleum.
Cloud	213	266	Clays, sand and gravel, stone.
Coffey	171	133	Stone, petroleum, sand and gravel.
Comanche	1,078	1,061	Natural gas, petroleum, sand and gravel.
Cowley	9,101	9,184	Petroleum, stone, sand and gravel, natural gas.
Crawford	1,609	1,740	Coal, petroleum, clays.
Decatur	1,960	1,806	Petroleum, sand and gravel.
Dickinson	410	556	Stone, sand and gravel, petroleum.

Table 2.—Value of mineral production in Kansas, by counties—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Doniphan	W	$307	Stone, sand and gravel.
Douglas	$517	575	Sand and gravel, petroleum.
Edwards	988	1,190	Natural gas, petroleum, sand and gravel.
Elk	1,169	1,229	Stone, petroleum, natural gas, sand and gravel.
Ellis	26,315	25,729	Petroleum, sand and gravel, stone.
Ellsworth	25,441	21,835	Natural gas liquids, helium, petroleum, salt, clays, sand and gravel, natural gas.
Finney	7,597	7,724	Natural gas, petroleum, natural gas liquids, sand and gravel.
Ford	555	489	Petroleum, natural gas liquids, sand and gravel, natural gas.
Franklin	437	395	Stone, clays, petroleum.
Geary	366	241	Stone, sand and gravel, petroleum.
Gove	864	716	Petroleum, sand and gravel.
Graham	14,180	12,960	Petroleum, stone.
Grant	35,203	41,388	Natural gas, natural gas liquids, helium, petroleum, sand and gravel.
Gray	W	W	Sand and gravel.
Greeley	4	12	Do.
Greenwood	9,034	8,328	Petroleum, stone, natural gas.
Hamilton	2,326	1,234	Natural gas, petroleum, sand and gravel.
Harper	3,729	3,539	Petroleum, natural gas liquids, natural gas, sand and gravel.
Harvey	2,808	2,735	Petroleum, natural gas, sand and gravel, natural gas liquids.
Haskell	14,328	13,735	Natural gas, petroleum, sand and gravel.
Hodgeman	4,655	4,478	Petroleum, sand and gravel.
Jackson	207	84	Petroleum, stone.
Jefferson	W	W	Stone.
Jewell	W	W	Stone, sand and gravel, volcanic ash.
Johnson	1,471	2,453	Stone, sand and gravel, petroleum.
Kearny	13,972	13,101	Natural gas, petroleum, natural gas liquids, sand and gravel.
Kingman	19,975	19,569	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kiowa	5,114	4,820	Natural gas, petroleum, sand and gravel.
Labette	310	268	Stone, petroleum.
Lane	216	155	Petroleum.
Leavenworth	474	533	Stone, sand and gravel, petroleum.
Lincoln	1,026	1,166	Stone, volcanic ash.
Linn	330	316	Petroleum, stone.
Logan	1	W	Volcanic ash, sand and gravel.
Lyon	1,200	1,259	Petroleum, sand and gravel, stone.
McPherson	7,406	7,723	Petroleum, sand and gravel, stone, natural gas, clays.
Marion	4,046	3,487	Petroleum, stone, natural gas, natural gas liquids.
Marshall	960	953	Gypsum, sand and gravel, stone.
Meade	4,313	4,084	Natural gas, petroleum, sand and gravel.
Miami	979	1,089	Petroleum, stone.
Mitchell	W	370	Sand and gravel.
Montgomery	6,780	6,339	Cement, petroleum, stone, clays.
Morris	1,082	1,010	Petroleum, stone, sand and gravel.
Morton	22,364	23,860	Natural gas, petroleum, helium, natural gas liquids.
Nemaha	67	98	Stone, petroleum, sand and gravel.
Neosho	9,032	9,895	Cement, petroleum, stone, clays, sand and gravel.
Ness	7,559	8,549	Petroleum, sand and gravel, stone.
Norton	1,421	1,289	Petroleum, sand and gravel, volcanic ash.
Osage	W	-------	
Osborne	291	221	Petroleum, sand and gravel.
Ottawa	-------	33	Sand and gravel.
Pawnee	2,944	2,878	Petroleum, natural gas, sand and gravel.
Phillips	6,287	6,411	Petroleum, stone, sand and gravel.
Pottawatomie	116	111	Sand and gravel, stone.
Pratt	5,084	5,406	Petroleum, natural gas, sand and gravel.
Rawlins	1,155	1,171	Petroleum, sand and gravel, stone.
Reno	20,530	14,778	Salt, petroleum, natural gas, sand and gravel.
Republic	11	W	Sand and gravel, stone.
Rice	21,563	20,462	Petroleum, salt, stone, natural gas, sand and gravel.
Riley	727	954	Stone, petroleum, sand and gravel.
Rooks	16,485	14,956	Petroleum, sand and gravel.
Rush	9,335	8,562	Helium, petroleum, natural gas, natural gas liquids.
Russell	25,945	25,527	Petroleum, sand and gravel, natural gas.
Saline	1,538	1,502	Petroleum, sand and gravel.
Scott	758	1,997	Natural gas liquids, helium, petroleum, natural gas.
Sedgwick	10,353	9,451	Petroleum, salt, natural gas liquids, sand and gravel.

See footnote at end of table.

Table 2.—Value of mineral production in Kansas, by counties—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Seward	$29,336	$30,392	Helium, natural gas liquids, natural gas, petroleum, sand and gravel.
Shawnee	1,325	1,516	Stone, sand and gravel.
Sheridan	1,287	1,967	Petroleum, sand and gravel.
Sherman	112	326	Lime, sand and gravel, petroleum.
Smith	(1)	3	Stone.
Stafford	13,653	12,690	Petroleum, natural gas, sand and gravel.
Stanton	4,229	4,352	Natural gas, petroleum.
Stevens	27,112	27,936	Do.
Sumner	7,321	6,178	Petroleum, sand and gravel, natural gas.
Thomas	W	W	Sand and gravel, petroleum.
Trego	3,595	3,770	Petroleum, sand and gravel.
Wabaunsee	900	908	Petroleum, stone, sand and gravel.
Wallace	83	W	Stone, sand and gravel.
Washington	193	W	Sand and gravel, stone.
Wichita	17	46	Sand and gravel.
Wilson	4,385	5,813	Cement, petroleum, stone, clays, natural gas.
Woodson	2,507	2,957	Petroleum, stone, sand and gravel.
Wyandotte	7,281	8,049	Cement, sand and gravel, stone.
Undistributed	3,788	5,817	
Total	574,068	568,701	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Less than ½ unit.

Table 3.—Indicators of Kansas business activity

	1967	1968[p]	Change (percent)
Employment and labor force, annual average:			
Total labor force (nonagricultural) thousands	865.1	872.7	+0.9
Unemployment do	23.8	23.2	−2.5
Employment:			
Construction do	31.0	35.0	+12.9
Mining do	11.8	11.4	−3.4
Manufacturing do	146.3	146.8	+.3
All industries do	841.3	849.5	+1.0
Personal income:			
Total millions	$6,961.0	$7,642.0	+9.8
Per capita	$3,052.0	$3,338.0	+9.2
Construction activity:			
Building permits, total private nonresidential millions	$79.4	$98.5	+24.0
Cement shipments to and within Kansas thousand 376-pound barrels	4,755	5,729	+20.5
Farm marketing cash receipts millions	$1,552.5	$1,480.3	−4.7
Mineral production do	$574.1	$568.7	−1.0

[p] Preliminary.

Sources: Survey of Current Business, Construction Review, Farm Income Situation, Kansas Employment Security Division.

Trends and Developments.—Kansas Gas & Electric Co. and Kansas City Power & Light Co. plan to build jointly an 840,000-kilowatt mine-mouth generating station near La Cygne in east Kansas. The installation would include a 3,100-acre reservoir to provide water for the plant, and 270 miles of 345,000-volt transmission lines. The Pittsburg & Midway Coal Mining Co. will supply coal from surface mines near the station. About 150 persons will be employed in the mining operation and 75 in the generating station. Completion was scheduled for early 1973.

Sunflower Electric Cooperative planned a gas-fired 94,500-kilowatt steam generating unit near Garden City. The Sunflower group is composed of cooperatives at Wheatland, Norton, Dighton, Wakeeney, Colby, Ulysses, Dodge City, and Bird City.

The potentialities for disposal of liquid wastes in subsurface formations in the Salina Basin of Kansas and in four other major structural basins in the United

States were studied and reported on by the American Association of Petroleum Geologists.[3] Among the problems reviewed were those of specific suitable host formations, fluid mechanics in deep disposal wells, and the strategic location of nuclear fuel reprocessing plants near deep formations that are suitable hosts for fluid wastes.

Interpace Corp. constructed a pilot plant at Mankato, Kans., for manufacturing filteraids, fillers, and insulation materials from a naturally occurring volcanic ash. The plant is part of a multi-million-dollar facility to make materials, aids, and equipment for the sugar, chemical, pharmaceutical, and vegetable oil industries and for use in waste water treatment.

Employment and Injuries.—According to the Employment Security Division of the Kansas Department of Labor, average annual employment in the mining industries in 1968 was 11,400, compared with 11,800 in 1967. Mining employment decreased for the ninth consecutive year.

Legislation and Government Programs.—The Kansas Legislature passed a mined-land conservation and reclamation act relating to coal mining, creating an 11-man board in the State Labor Department for administration of the act. The act requires a permit and bond to assure the performance of the requirements of the act. The amount of bond, determined by the board, shall not be less than $200 nor more than $500 per acre, with a minimum bond of $2,000. Kansas Legislature passed an act providing for establishment of ground water districts.

Drilling and Exploration.—During 1968, operators drilled 1,183 exploratory wells comprising 170 oil wells, 20 gas wells, and 993 dry holes.

Some of the more productive discovery wells were those in the Woerpel field, Rawlins County (producing from strata within the Lansing Group), 160 barrels of oil per day; Stukenbroker field, Seward County (Ste. Genevieve Formation), 235 barrels of oil per day; La Cross field, Rush County (Lansing-Kansas City Groups), 145 barrels of oil per day; North Hugoton field, Scott County (Mississippian System), 256 barrels of oil per day; West Roesler field, Barton County (Kansas City Group), 354 barrels of oil per day; Northeast Petersilie field, Ness County (Marmaton Group), 161 barrels of oil per day; Ung field, Decatur County (Kansas City Group), 155 barrels of oil per day; and Solomon Fork field, Sheridan County (Lansing Group), 238 barrels of oil per day.

In 1968, 3,032 wells were completed. For the last 10 years, total completions have averaged 3,828 wells per year.

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[3] Galley, John E. The American Association of Petroleum Geologists, Memoir 10, Subsurface Disposal In Geologic Basins. August 1968, 253 pp.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1967:								
Coal	216	226	49	359	-------	9	25.06	457
Metal	84	254	21	173	-------	12	69.49	1,813
Nonmetal	1,224	238	291	2,318	1	50	22.00	2,932
Sand and gravel	787	251	198	1,700	1	23	14.12	3,820
Stone	1,623	257	417	3,442	-------	41	11.91	452
Total	3,934	248	976	7,992	2	135	17.14	1,917
1968:p								
Coal	250	221	55	405	-------	11	27.13	488
Metal	70	202	14	111	-------	7	62.79	1,839
Nonmetal	1,235	252	311	2,495	-------	74	29.66	978
Sand and gravel	965	240	231	2,034	-------	39	19.17	479
Stone	1,650	256	422	3,495	1	38	11.16	2,045
Total [1]	4,170	248	1,033	8,541	1	169	19.91	1,284

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Carbon Black.—Columbian Carbon Co. produced carbon black from liquid hydrocarbons and natural gas at its Hickok, Kans., plant.

Goodyear Tire & Rubber Co. announced an expansion program at its Topeka plant, which will include a new carbon black tower with a capacity of 420 tons and a new Branbury mixer in which carbon black will be mixed with chemicals and rubber to produce rubber stock used in manufacturing tires.

Coal.—Four strip mines in Cherokee and Crawford Counties each reported output of 1,000 tons or more per year; production of less than 1,000 tons was credited to three strip mines in Linn and Osage Counties. Over 99 percent of total coal mined was mechanically cleaned at three cleaning plants. About 98 percent of the coal was shipped to consumers by rail and 2 percent by truck.

Table 5.—Coal (bituminous) production[1]

(Thousand short tons and thousand dollars)

Year	Number of mines[2]	Quantity	Value
1964	7	1,263	$5.749
1965	6	1,310	6,072
1966	5	1,122	5,355
1967	5	1,136	5,294
1968	4	1,268	6,526

[1] Excludes mines producing less than 1,000 short tons.

[2] All strip mines.

Helium.—Production of helium began near Scott City at a new plant jointly owned by subsidiaries of Kansas-Nebraska Natural Gas Co. and Cities Service Co.; Cities Service Cryogenics, Inc., operated the helium recovery plant. The helium was refined and liquefied at Ulysses by Cities Service Helex Co. Other producers of Grade-A and liquefied helium were Kansas Refined Helium Co. at Otis and Alamo Chemical Co.-Gardner Cryogenics, Inc., at Elkhart.

Total 1968 Grade-A helium production from the three plants, which are independent of the Federal Helium Conservation Program was 291.7 million cubic feet valued at $7.3 million, compared with 225 million cubic feet valued at $5.4 million in 1967.

Four plants in the State recovered crude helium (50 to 80 percent pure) under the Federal long-range helium conservation program—Northern Helex plant near Bushton; Cities Service Helex plant near Ulysses; National Helium Corp. plant near Liberal, and the Bureau of Mines plant near Otis. The Otis plant discontinued operations April 30, 1968. The four plants produced a combined total of 2,749.7 million cubic feet of helium in 1968, valued at $33.6 million. About 133.1 million cubic feet of the 1968 production was in excess of Government contract limits and was sold by the companies to private industry plants for purification and marketing. The remainder was purchased by the Bureau of Mines and stored in the partially depleted Cliffside gasfield near Amarillo, Tex. When needed, the helium will be withdrawn, purified, and sold.

Natural Gas.—With an output of 835,555 million cubic feet, Kansas ranked fifth in the Nation in production of marketed natural gas. In response to engineering studies, that indicated compressors could increase gas production in the Laredo gasfield, Reno County, from 2 million to 5.8 million cubic feet per day, the Kansas Corporation Commission approved construction of the first gas-producing unit proposed under the State's new unitization law. Life of the field would be extended 7 years and an additional 8 billion cubic feet of gas should be recovered.

Cities Service Gas Co. increased the output of low-pressure wells by adding three 2,000-horsepower compressor units 21 miles northwest of Ulysses.

Table 6.—Marketed production of natural gas

Year	Million cubic feet	Value (thousands)
1964	764,073	$96,031
1965	793,379	105,519
1966	847,495	114,412
1967	871,971	116,844
1968	835,555	115,307

The Kansas Corporation Commission listed 64 firms as purchasing gas in the

State. Four of the purchasers operated underground storage reservoirs having a total capacity of 103.4 billion cubic feet of natural gas; gas stored was recovered for use during peak consumption periods. On January 1, 1968, the firms had 90.4 billion cubic feet of natural gas in the underground storage.

At yearend 8,579 gas wells produced from 283 gasfields.

Natural Gas Liquids.—Kansas ranked sixth in the Nation as a producer of natural gas liquids, supplying 3.7 percent of the domestic output. Proved recoverable reserves of natural gas liquids in the State were 270.6 million barrels at yearend, according to the Committee on Natural Gas Reserves of the American Gas Association.

Cities Service Oil Co. doubled the processing capacity for natural gas liquids at its Hutchinson fractionation and underground storage center. Products of the plant—propane, butane, isobutane, and natural gasoline—are shipped by pipeline, truck, and rail to Midwest markets. Ten new underground storage caverns boosted Cities Service Oil Co. total storage capacity to 235 million gallons. Kansas, with 13.2 percent of the Nation's underground storage for LP gases, can store 20.2 million barrels underground.

Petroleum.—Increased allowables of the Kansas Corporation Commission did not check the downward trend of crude oil production. In 1968, Kansas oilfields yielded approximately 259,000 barrels of crude oil per day, but refinery demand was about 371,000 barrels of oil per day. Producers from Oklahoma, Texas, New Mexico, Colorado, Nebraska, Wyoming, and Montana shipped oil into Kansas for refining.

Kansas ranked seventh in the Nation as a crude oil producer, supplying 2.8 percent of the domestic output. Producing wells at the end of 1968 totaled 45,145, contrasted with 47,597 at the end of 1967.

Refineries.—Twelve refineries operated in Kansas during 1968. Crude oil capacity increased to 407,300 barrels per day from 399,500 barrels per day in 1967.[4] Kansas, in 1968, produced about 70 percent of the crude oil run to its refineries.

An improvement program, announced for the oil refinery of CRA, Inc., Coffeyville, included renovation of the alkylation unit and erection of a 200-foot tower for separation of various components used in high-octane fuel production.

Derby Refining Co. at Wichita, Kans., increased capacity of the ultraforming unit from 2,800 to 5,000 barrels per day and the hydrofining unit from 4,000 to 5,000 barrels per day. Boilers were also modified to make cleaner stack gases.

Skelly Oil Co. planned a new gas liquids unit at its El Dorado refinery to recover ethane, ethylene, propane, propylene, and isobutane fractions from gas streams generated in various refinery processes.

Pipelines.—A major pipeline system for transporting anhydrous ammonia from Borger, Tex., to Garner, Iowa, was completed by Mid-America Pipeline System, a Division of MAPCO, Inc. The facility has a terminal and electric pump station at Conway, Kans., and will serve farming areas in Kansas, Nebraska, and Iowa. The starting capacity of 1,300 tons of ammonia fertilizer per day can be expanded to 5,000 tons per day by increasing the pumping equipment. The system is controlled from a central dispatching office in Tulsa, Okla.[5] LP-gas may be transported in the line during the off season for farmers applying fertilizer.

Skelly Oil Co. planned two 70-mile pipelines to connect its El Dorado refinery with

Table 7.—Natural gas liquids production

(Thousand 42-gallon barrels and thousand dollars)

Year	Natural gasoline		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	3,874	$8,713	12,208	$18,121	16,082	$26,834
1965	3,654	7,791	13,986	22,322	17,640	30,113
1966	4,168	9,399	15,813	25,902	19,981	35,301
1967	4,623	10,703	15,835	31,923	20,458	42,626
1968	4,824	10,977	15,748	25,827	20,572	36,804

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[4] The Oil and Gas Journal. V. 67, No. 12, Mar. 24, 1969, p. 116.

[5] The Oil and Gas Journal. V. 66, No. 44, Oct. 28, 1968, pp. 113–117.

Table 8.—Natural gasoline and LP gases produced in 1968

(42-gallon barrels)

Company	Location: Nearest town	Location: County	Natural gasoline	Butane	Propane	LP gases	Total
Alamo Chemical Co	Elkhart	Morton	391,775	---------	---------	---------	391,775
Anadarko Production Co.	Liberal	Seward	78,016	---------	39,421	---------	117,437
	Elkhart	Morton	104,285	---------	60,833	---------	165,118
Cities Service Cryogenics, Inc.	Scott City	Scott	---------	---------	---------	466,433	466,433
Cities Service Helex, Inc.	Ulysses	Grant	---------	---------	---------	3,788,390	3,788,390
Cities Service Oil Co	Cheney	Kingman	---------	---------	---------	576,000	576,000
	Midway	do	---------	---------	---------	232,000	232,000
	Wichita	Sedgwick	322,000	344,000	275,000	---------	941,000
	Wilburton	Morton	---------	---------	---------	55,000	55,000
Colo. Interstate Gas Co.	Lakin	Kearny	109,561	---------	---------	---------	109,561
Hugoton Production Co.	Ulysses	Grant	229,954	241,013	238,560	---------	709,527
Kansas-Nebraska Natural Gas Co., Inc.	Scott City	Scott	---------	---------	---------	204,088	204,088
Kansas Refined Helium Co.	Otis	Rush	38,480	---------	---------	---------	38,480
Mobil Oil Corp	Spivey	Harper	318,679	166,206	304,329	---------	789,214
	Hickok	Grant	153,781	2,127	106,901	414,542	677,351
National Helium Corp.	Liberal	Seward	975,627	1,215,753	2,186,163	---------	4,377,543
Northern Gas Products Co.	Bushton	Ellsworth	708,630	1,998,889	5,210,943	---------	7,918,462
Northern Natural Gas Co.	Holcomb	Finney	174,605	---------	---------	---------	174,605
	Sublette	Seward	382,644	---------	---------	---------	382,644
Pan American Petrol. Corp.	Ulysses	Grant	717,789	998,151	722,938	---------	2,438,878
	do	do	54,482	59,347	97,502	---------	211,331
Plateau Natural Gas Co.	Burrton	Harvey	6,730	---------	---------	---------	6,730
Rounds & Stewart Nat. Gasoline Co., Inc.	Marion	Marion	48,903	51,149	97,469	---------	197,521
Skelly Oil Co	Medicine Lodge	Barber	54,985	---------	46,597	---------	101,582
	Minneola	Ford	59,715	---------	53,344	---------	113,059

Source: Kansas State Corporation Commission.

Table 9.—Crude petroleum production

(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value
1964	106,252	$310,256
1965	104,733	305,820
1966	103,738	306,027
1967	99,200	297,600
1968	94,505	285,405

the Mid-America Pipeline Co. system at Conway. A 4-inch line will move an ethane-propane mix, and a 6-inch line will carry LP gas products. Plans include a 4-inch products line from Conway to a proposed terminal at Great Bend, Kans.

Williams Bros. Pipeline Co. let construction contracts for a 16-inch products line between El Dorado and Topeka, Kans., and between Topeka, Kans., and St. Joseph, Mo.

Petrochemicals.—Farmland Industries, Inc., fertilizer plant east of Dodge City, operated a new 600-ton-per-day anhydrous ammonia unit during the latter part of the year. The plant, which services farm cooperatives in Kansas, Oklahoma, Texas, and Colorado, used 2,200 pounds of air, 1,600 gallons of water, and 21 million cubic feet of natural gas for each ton of ammonia produced. The new plant has storage for 61,000 tons of anhydrous ammonia.

Natural gas, petroleum fractions, naphtha fractions, catalytic reformate, carbon tetrachloride, chloroform, and hydrofluoric acid are reported feedstocks for the petrochemical industry in Kansas. Plants that process petrochemicals include Cooperative Farm Chemicals Association, Lawrence; Farmland Industries, Inc., Dodge City; Phillips Petroleum Co., Kansas City; Racon,

Table 10.—Crude petroleum production, indicated demand, and stocks in 1968, by months

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Kansas (end of month)
January	8,168	8,566	6,065
February	7,742	8,208	5,599
March	8,125	7,438	6,286
April	8,104	7,730	6,660
May	8,032	7,728	6,964
June	7,756	8,017	6,703
July	8,046	7,521	7,228
August	7,842	8,393	6,677
September	7,802	7,797	6,682
October	7,919	7,910	6,691
November	7,511	7,644	6,558
December	7,458	8,171	5,845
Total:			
1968	94,505	95,123	XX
1967	99,200	98,514	XX

XX Not applicable.

Inc., Wichita; Reichhold Chemicals, Inc., Kansas City; Skelly Oil Co., El Dorado; Vickers Petroleum Co., Inc., Potwin; and Vulcan Materials Co., Wichita. Products are numerous and varied, including items that have direct applications such as fertilizer, fumigants, and solvents, and items that are used in manufacturing or preparing other materials or commodities.

NONMETALS

Cement.—The increased demand for Kansas portland cement resulted from gains in commercial building and highway construction.

Six companies (table 23) produced 9.9 million barrels of portland cement. Approximately 62 percent of the cement was produced by the wet process and 38 percent by the dry process. Sixty-eight percent of the shipments were by rail and 32 percent by truck. Ninety-three percent of the shipments were in bulk and 7 percent in paper bags. Shipments to customers were distributed in the following manner: Ready-mixed concrete companies, 55 percent; highway contractors, 17 percent; other contractors, 5 percent; building material dealers, 6 percent; concrete product manufacturers, 12 percent; and miscellaneous customers, 5 percent.

Masonry cement was produced at all portland cement plants and at a natural cement plant in Bourbon County.

Clays.—Decreased activity in residential construction accounted for the reduced clay output.

Thirteen firms produced clay and shale from 23 sources in Kansas. The use pattern of Kansas clay and shale was 43 percent for cement; 27 percent for building brick; 30 percent for sewer pipe, lightweight aggregate, heavy clay products, and stoneware and pottery.

W. S. Dickey Manufacturing Company at its Pittsburg plant, reportedly, has patented equipment that will horizontally extrude bell and spigot clay pipe in a full

Table 11.—Crude petroleum production by fields[1]

(Thousand 42-gallon barrels)

Field [2]	1965	1966	1967	1968	Cumulative Dec. 31, 1968
Alameda	-------	---------	1,441	1,378	5,555
Bemis-Shutts	3,371	3,267	3,101	3,072	203,975
Chase-Silica	2,690	2,579	2,297	2,099	242,038
El Dorado	2,899	2,534	2,294	2,062	271,261
Geneseo-Edwards	1,212	1,187	1,138	1,027	76,237
Gorham	1,328	1,275	1,191	1,128	73,966
Hall-Gurney	3,345	3,290	3,156	3,057	113,708
Kraft-Prusa	1,942	1,992	1,834	1,739	105,034
Ray	1,147	1,132	1,140	1,117	34,784
Spivey-Grabs	3,168	2,796	2,540	2,403	37,651
Trapp	2,772	3,055	2,467	2,314	193,463
Other fields [3]	80,859	80,631	76,601	73,109	NA
Total	104,733	103,738	99,200	94,505	NA

NA Not available.

[1] Fields with annual production in excess of 1 million barrels.

[2] Breakdown for individual fields from The Oil and Gas Journal.

[3] Bureau of Mines figures.

Table 12.—Oil and gas well drilling in 1968, by counties

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Allen	35	------	26	------	------	------	61
Anderson	9	------	8	------	------	7	24
Atchison	------	------	1	------	------	------	1
Barber	13	10	14	5	14	30	86
Barton	52	1	68	14	------	54	189
Bourbon	1	------	11	1	------	33	46
Brown	------	------	------	------	------	1	1
Butler	41	------	31	6	------	22	100
Chase	2	------	------	------	------	------	2
Chautauqua	28	4	16	1	1	11	61
Clark	2	------	2	------	------	5	9
Cloud	------	------	------	------	------	1	1
Coffey	5	------	4	------	------	1	10
Comanche	2	------	3	------	5	15	25
Cowley	48	1	20	5	------	21	95
Crawford	4	------	4	------	------	1	9
Decatur	11	------	4	6	------	14	35
Dickinson	8	------	2	------	------	5	15
Doniphan	------	------	------	------	------	1	1
Douglas	1	------	2	------	------	1	4
Edwards	1	5	3	2	5	11	27
Elk	12	------	3	------	------	4	19
Ellis	61	1	63	15	------	77	217
Ellsworth	5	------	7	1	------	9	22
Finney	------	1	------	1	------	4	6
Ford	2	------	------	------	------	6	8
Franklin	4	------	8	------	------	1	13
Geary	------	------	1	------	------	------	1
Gove	4	------	3	2	------	10	19
Graham	29	------	30	9	------	52	120
Grant	------	3	------	------	------	1	4
Gray	------	------	------	------	------	1	1
Greeley	------	------	------	------	------	1	1
Greenwood	111	1	61	------	------	17	190
Hamilton	------	2	------	------	------	------	2
Harper	17	3	6	2	2	18	48
Harvey	15	1	10	2	------	8	36
Haskell	2	------	1	------	------	------	3
Hodgeman	4	------	6	5	1	20	36
Jackson	------	------	------	------	------	3	3
Jefferson	------	------	------	------	1	1	2
Johnson	------	1	2	------	1	1	5
Kearny	------	------	3	------	------	1	4
Kingman	5	10	8	2	1	32	58
Kiowa	13	8	5	6	16	35	83
Labette	5	2	4	------	------	1	12
Lane	------	------	------	------	------	1	1
Leavenworth	------	------	------	------	------	2	2
Linn	4	4	8	2	------	1	19
Lyon	10	------	4	1	------	3	18
McPherson	23	------	6	------	------	10	39
Marion	18	------	5	------	------	9	32
Meade	2	1	2	1	4	7	17
Miami	16	1	7	------	1	------	25
Montgomery	24	1	17	------	------	------	42
Morris	------	------	------	------	------	5	5
Morton	2	2	4	------	3	5	16
Nemaha	1	------	------	------	------	------	1
Neosho	10	1	23	------	------	4	38
Ness	28	------	19	15	------	42	104
Norton	------	------	1	------	------	12	13
Osage	------	------	------	------	------	1	1
Osborne	------	------	1	1	------	------	2
Pawnee	9	2	6	7	------	13	37
Phillips	11	------	2	1	------	11	25
Pottawatomie	------	------	------	------	------	1	1
Pratt	19	2	8	7	------	29	65
Rawlins	2	------	1	1	------	12	16
Reno	24	------	7	3	------	16	50
Rice	46	------	28	5	------	23	102
Riley	------	------	2	------	------	------	2
Rooks	33	1	19	11	------	23	87
Rush	24	18	20	8	4	28	102
Russell	61	1	41	12	------	31	146
Saline	4	------	3	2	------	7	16
Scott	------	------	1	------	------	3	4

See footnote at end of table.

Table 12.—Oil and gas well drilling in 1968, by counties—Continued

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Sedgwick	2	------	3	1	------	12	18
Seward	2	3	4	1	5	3	18
Sheridan	9	------	11	6	------	35	61
Stafford	30	1	29	17	1	38	116
Stanton	------	------	1	------	------	1	2
Stevens	1	4	2	1	1	3	12
Sumner	9	1	19	3	------	38	70
Trego	13	1	14	9	------	23	60
Wabaunsee	------	------	------	------	------	4	4
Wichita	------	------	------	1	------	4	5
Wilson	23	------	8	------	------	1	32
Woodson	19	3	16	1	------	4	43
Wyandotte	------	------	------	------	1	------	1
Total	1,031	101	782	202	67	1,002	3,185

Source: American Association of Petroleum Geologists.

Table 13.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

Product	Proved reserves Dec, 31, 1967	Changes in proved reserves, due to extensions, revisions, and new discoveries, in 1968	Proved reserves Dec. 31, 1968 (production was deducted)	Changes from 1967 (percent)
Crude oil ---- thousand barrels	625,121	69,786	600,842	—3.9
Natural gas liquids [1] ---- do	271,952	16,076	270,556	—0.5
Natural gas ---- million cubic feet	15,283,657	69,572	14,511,173	—5.1

[1] Includes condensate, natural gasoline, and LP gases.

Source: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas. Tulsa Daily World, 64th yr., No. 206, April 7, 1969, p. 10.

Table 14.—Portland cement production and shipments

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1964	8,335	8,483	$25,959
1965	8,877	8,801	26,972
1966	9,174	8,979	27,246
1967	9,023	8,833	25,545
1968	9,887	9,680	29,898

Table 15.—Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	785	$935
1965	789	953
1966	847	1,006
1967	935	1,339
1968	932	1,433

range of sizes through a 36-inch diameter. Structural advantages of using the equipment include greater density, superior strength, and excellent dimensional uniformity in the products.[6]

Gypsum.—Production of crude gypsum decreased 5 percent and the calcined portion 4 percent from that of 1967 because of the decline in residential construction. Crude gypsum was used as a retarder in portland cement and as a filler in other products. Principal uses of calcined gypsum were in manufacturing wallboard and wall plaster.

Lime.—Construction of lime kilns by Great Western Sugar Company, 5 miles west of Goodland, was completed. Limestone from the company mine in Wyoming was calcined to make lime for clarifying and purifying sugar. The Goodland plant is second largest of the company's 18 operations.

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[6] Brick & Clay Record. V. 153, No. 3, September, 1968, p. 18.

Perlite.—Crude perlite, mined out-of-State, was processed by Lite-Weight Products, Inc., at its plant in Kansas City. The expanded perlite was used as a carrying agent for fertilizer, building plaster aggregate, concrete aggregate, loose fill insulation, soil conditioner, and filler material.

Pumice.—Output of pumice gained in 1968 as compared with 1967 output, due to increased use in road construction. Pumice also was used in cleansing and scouring compounds, as insulating material, as a filler in the fabrication of lightweight molded articles, and as a carrier for liquid fertilizers.

Salt.—Evaporated and rock salt were produced in Barton, Ellsworth, Reno, and Rice Counties. Three companies mined rock salt, five recovered evaporated salt; two of the companies produced both rock and evaporated salt. Another operator pumped brine from wells in Sedgwick County which yielded chlorine and caustic soda. Evaporated salt output increased almost 7 percent and rock salt gained more than 4 percent.

Most of the Kansas salt was used for snow and ice removal and by the livestock industry. Other uses included chemicals, in road bed stabilization, and in water-softener regeneration.

Barton Salt Co. was adding new evaporating equipment in a modernizing program at their Hutchinson plant. Plant capacity was expected to be increased about 20 percent.

Cargill Inc., at Pawnee Rock, Kans., increased its evaporation plant capacity 58 percent, and built a 4,000-square-foot warehouse.

Morton Salt Co. installed a new set of vacuum pans, built a new cooling unit, and drilled new brine wells at their Hutchinson plant. Plant capacity was raised about 60 percent. Two new silos, each housing a storage capacity of 500 tons, were being constructed.

Sand and Gravel.—Production gains in sand and gravel paralleled gains in commercial building and highway construction. Ninety-one percent of total output was used in building and highway construction, with highway paving consuming 59 percent.

Sand and gravel was recovered in 79 counties, principally by commercial operators who supplied 83 percent of the total output. Thirty of 113 reporting commercial operators produced 71 percent of the commercial sand and gravel. Twelve commercial operators individually produced more than 200,000 tons; 36 operators produced less than 25,000 tons, and the other operators' output was between 25,000-200,000 tons.

County production statistics reveal the influence of urban demands for sand and gravel. Sand and gravel recovered in Wyandotte County adjacent to Kansas City was 2.1 million tons. Deposits in Sedgwick County near Wichita yielded 1.8 million tons. Supplies for Topeka of 547,000 tons came from surrounding Shawnee County, and for the Salina area 520,000 tons came from Saline County. Production was less than half a million tons in each of the other counties.

Stone.—Production increased by 6.3 percent over that of 1967. Gains, made chiefly in limestone for concrete aggregate, roadstone, agricultural stone (agstone), cement, and dimension stone, were partially offset by losses in other categories. Production was recorded at 167 operations that were

Table 16.—Evaporated and rock salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Evaporated salt		Rock salt	
	Quantity	Value	Quantity	Value
1964	438	$9,485	492	$2,314
1965	453	9,828	600	2,548
1966	452	10,836	517	2,552
1967	521	12,085	548	2,601
1968	556	12,875	572	2,644

Table 17.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	10,227	$7,788	2,741	$1,320	12,968	$9,108
1965	9,960	7,494	2,584	979	12,544	8,473
1966	9,316	7,193	2,311	1,181	11,627	8,374
1967	8,510	6,727	3,556	1,922	12,066	[1] 8,650
1968	10,267	8,953	2,160	1,608	12,427	[1] 10,559

[1] Data does not add to total shown because of independent rounding.

Table 18.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,450	$2,822	3,753	$3,086
Paving	2,207	1,677	3,489	3,068
Fill	1,049	546	884	444
Other [1]	227	222	115	137
Total	6,933	5,267	8,241	6,735
Gravel:				
Building	309	337	259	238
Paving	1,180	1,014	1,673	1,742
Fill	28	31	10	12
Other [2]	60	78	84	226
Total	1,577	1,460	2,026	2,218
Total sand and gravel	8,510	6,727	10,267	8,953
Government-and-contractor operations:				
Sand:				
Building	165	165	--------	--------
Paving	1,432	726	1,316	950
Fill	5	3	23	18
Total	1,602	894	1,339	968
Gravel:				
Paving	1,954	1,029	820	638
Fill	--------	--------	1	--------
Total	1,954	1,029	821	638
Total sand and gravel	3,556	[3] 1,922	2,160	[3] 1,608
Grand total	12,066	[3] 8,650	12,427	[3] 10,559

[1] Includes railroad ballast, other construction, and industrial sand (ground and unground).
[2] Includes railroad ballast (1967), other construction, and miscellaneous gravel.
[3] Data does not add to total shown because of independent rounding.

scattered through 52 counties. Limestone comprised 94 percent of total output; the remaining output was for sandstone, quartzite, and chat.

Quarrying was predominantly in the eastern half of the State, although operations scattered through seven counties in the western half yielded about 100,000 tons, principally limestone. Distribution of operations was due partly to large demand for construction materials in the urban centers in the east, which are in the area of the most abundant and accessible stone resources, and partly to the sparsity and generally inaccessible nature of stone resources in the west.

Table 19.—Sand and gravel production in 1968, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Barton	209	$157	Meade	18	$10
Brown	3	3	Mitchell	389	370
Butler	2	5	Morris	15	7
Chase	20	10	Nemaha	6	6
Cherokee	9	7	Ness	18	9
Clark	17	12	Norton	23	11
Clay	84	W	Osborne	66	48
Coffey	10	6	Ottawa	34	33
Comanche	19	14	Phillips	23	12
Cowley	365	277	Pratt	195	120
Decatur	46	31	Rawlins	10	5
Dickinson	72	72	Reno	448	265
Doniphan	7	7	Republic	235	W
Douglas	483	431	Rice	139	67
Edwards	30	32	Russell	109	64
Elk	22	11	Saline	520	W
Ellis	134	114	Sedgwick	1,827	1,170
Finney	113	W	Seward	86	145
Gove	39	34	Sheridan	56	39
Greeley	11	12	Sherman	99	106
Hamilton	14	11	Sumner	149	96
Harper	110	124	Trego	11	6
Haskell	48	24	Wabaunsee	16	19
Hodgeman	73	55	Wallace	11	5
Jewell	14	10	Wichita	61	46
Johnson	449	383	Woodson	4	2
Kearny	50	42	Wyandotte	2,067	1,900
Kiowa	104	68	Other counties [1]	3,209	4,018
Leavenworth	20	30			
Logan	6	3	Total	12,427	10,559

W Withheld to avoid disclosing individual company confidential data; included with other counties.

[1] Includes Barber, Cheyenne, Cloud, Ellsworth, Ford, Geary, Grant, Gray, Harvey, Kingman, Lyon, McPherson, Marshall, Neosho, Pawnee, Pottawatomie, Riley, Rooks, Shawnee, Stafford, Thomas and Washington Counties. Undistributed amounts from various counties are also included.

Table 20.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Limestone [1]		Other stone		Total stone	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	13,412	$17,747	726	$1,165	14,138	$18,912
1965	14,673	19,566	597	972	15,270	20,538
1966	13,503	17,886	524	903	14,027	18,789
1967	12,776	16,594	775	1,212	13,551	17,806
1968	13,558	19,267	844	1,447	14,402	20,714

[1] Includes limestone for cement.

Maximum output in individual counties—1.4 million tons in Johnson County and 1.3 million tons in Wyandotte County—was attained adjacent to Kansas City. Large tonnages were quarried, also, in Shawnee and Jefferson Counties, supplying the Topeka-Lawrence area. Allen, Neosho, Wilson, Montgomery, and Elk Counties, as a group in southeastern Kansas, are credited with 3.4 million tons of stone of which 98.9 percent was limestone and 1.1 percent was sandstone. Cement manufacture consumed 68 percent of the stone quarried in these five counties. More than half a million tons of stone was quarried in Lincoln County, central Kansas, for heavy construction.

Water.—Kansas Gas & Electric Co. requested water rights at the John Redmond Reservoir for use as a coolant in a planned nuclear-powered electric generating plant. Water from the reservoir would be pumped through the plant's cooling system into a holding basin, remaining there until cool enough to be returned to the lake without causing a large rise in water temperatures.

Table 21.—Stone sold or used by producers, by kinds and uses

(Thousand short tons and thousand dollars)

Uses	1967		1968	
	Quantity	Value	Quantity	Value
Limestone:				
Riprap	W	W	369	$381
Concrete aggregate and roadstone	8,435	$11,208	8,871	12,803
Agriculture	546	885	780	1,281
Cement	2,686	2,848	3,162	3,726
Dimension	7	508	10	532
Other [1]	1,102	1,145	364	544
Total [2]	12,776	16,594	13,558	19,267
Sandstone: Dimension	([3])	4	([3])	4
Total stone [2] [4]	13,551	17,806	14,402	20,714

W Withheld to avoid disclosing individual company confidential data; included in total.
[1] Includes riprap (1967), flux (1967); railroad ballast, whiting, and other uses.
[2] Data may not add to totals shown because of independent rounding.
[3] Less than ½ unit.
[4] Includes crushed sandstone, and miscellaneous stone.

An act passed by the Kansas Legislature states the legal procedure for establishing a ground water district, prescribes the powers of administrative officials of the district, and defines areas and scope of operations upon which such a district might properly embark.[7]

METALS

The Kansas zinc and lead producing area in Cherokee County is part of the Tri-State District, which includes northeastern Oklahoma and southwestern Missouri.

Lead and Zinc.—Eight small zinc-lead mines operated in the Kansas portion of the Tri-State District. Four of the mines produced 95 percent of the ore. The value of zinc recovered was 2½ times the value of lead. Eagle-Picher Industries, Inc., neared completion of the incline on the Swalley lease near Baxter Springs, Kans. Ore from the mine will be treated and concentrated at the company mill at Cardin, Okla. Concentrates will be calcined at the company plant at Galena, Kans., and the calcined product will be processed at the National Zinc Co. smelter at Bartlesville, Okla.

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[7] Kansas Water Resources Board. 1968 Kansas Legislation on Water. Kansas Water News (Topeka, Kans.), v. 11, No. 3, April 1968, p. 8.

Table 22.—Mine production of lead and zinc, in terms of concentrate and recoverable metals[1]

Year	Mines producing	Lead concentrate (galena)		Zinc concentrate (sphalerite)		Recoverable metal content [2]			
						Lead		Zinc	
		Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1964	10	1,603	$228	8,636	$768	1,185	$310	4,665	$1,269
1965	9	2,304	380	12,003	1,157	1,644	513	6,508	1,900
1966	9	1,574	242	8,911	849	1,109	335	4,769	1,383
1967	10	1,486	209	8,832	817	1,031	289	4,765	1,319
1968	10	1,780	234	5,588	490	1,227	324	3,012	813

[1] Based on Kansas ore and old tailing treated at mills during calendar year indicated.
[2] In calculating metal content of the ores from assays, allowance made for smelting losses of both lead and zinc. In comparing values of concentrate (ore) and metal, value given for concentrate is that actually received by producer, whereas value of lead and zinc is calculated from average price for all grades.

Table 23.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ash Grove Lime & Portland Cement Co.	Kansas City, Mo. 64105	Quarry and plant	Neosho.
General Portland Cement Co.	Fredonia, Kans. 66736	do	Wilson.
Lehigh Portland Cement Co.	Allentown, Pa. 18105	do	Allen.
Lone Star Cement Corp.	Indianapolis, Ind. 46205	do	Wyandotte.
The Monarch Cement Co.	Humboldt, Kans. 66748	do	Allen.
Universal Atlas Cement Co. Div. of U. S. Steel Corp.	Pittsburgh, Pa. 15230	do	Montgomery.
Clays:			
Acme Brick Co.	Fort Worth, Tex. 76101	Mine and plant	Cherokee, Ellsworth.
Ash Grove Cement Co.	Kansas City, Mo. 64105	do	Neosho.
Buildex, Inc.	Pittsburg, Kans. 66762	do	Franklin, McPherson.
Cloud Ceramics	Concordia, Kans. 66901	do	Cloud.
Excelsior Clay Prod., Inc.	Wichita, Kans. 67202	do	Wilson.
General Portland Cement	Fredonia, Kans. 66736	do	Do.
Humboldt Shale Mining Co.	Humboldt, Kans. 66748	do	Allen.
Kansas Brick & Tile	Hoisington, Kans. 67544	do	Barton, Ellsworth.
Lehigh Portland Cement	Allentown, Pa. 18105	do	Allen.
Monarch Cement Co.	Humboldt, Kans. 66748	do	Do.
Universal Atlas Cement Co. Div. of U. S. Steel Corp.	Pittsburgh, Pa. 15230	do	Montgomery.
Coal:			
Cliff Carr Coal Co.	Mulberry, Kans. 66756	Strip mine	Crawford.
The Clemens Coal Co.	Pittsburg, Kans. 66762	do	Do.
Pittsburg & Midway Coal Mining Co.	Kansas City, Mo. 64105	do	Cherokee.
Wilkinsons, Inc.	Weir, Kans. 66781	do	Do.
Gypsum:			
Georgia-Pacific Corp. Bestwall Gypsum Co. Div.	Portland, Ore. 97207	Quarry and plant	Marshall.
National Gypsum Co.	Buffalo, N.Y. 14202	do	Barber.
Lead and Zinc:			
Eagler-Picher Indust., Inc.	Miami, Okla. 74354	Underground mine	Cherokee.
M & M Mining Co.	Picher, Okla. 74360	do	Do.
Mid-Continent Lead & Zinc	Baxter Spring, Kans. 66713	do	Do.
Quapaw Co.	Picher, Okla. 74360	do	Do.
Scotty Mining Co.	Baxter Spring, Kans. 66713	do	Do.
Pumice:			
Ernest Hanzlicek	Wilson, Kans. 67490	Mine	Lincoln.
Interpace Corp.	Mankato, Kans. 66956	do	Jewell.
San Ore Const. Co., Inc.	McPherson, Kans. 67460	do	Logan.
Wyandotte Chemical Corp.	Wyandotte, Mich. 48192	Mine and plant	Norton.
Salt:			
American Salt Corp.	Kansas City, Mo. 64111	Brine wells and underground mine.	Rice.
The Barton Salt Co.	Hutchinson, Kans. 67501	Brine wells	Reno.
The Carey Salt Co.	do	Brine wells and underground mine.	Do.
Cargill, Inc.	Minneapolis, Minn. 55402	Brine wells	Barton.
Independent Salt Co.	Kanopolis, Kans. 67454	Underground mine	Ellsworth.
Morton Salt Co.	Chicago, Ill. 60606	Brine wells	Reno.
Vulcan Materials Co.	Wichita, Kans. 67201	do	Sedgwick.
Sand and Gravel:			
American Sand Co.	Kansas City, Kans. 66106	Dredge	Wyandotte.
Builders Sand Co.	do	Pit	Do.
John Alsop Sand Co.	Belleville, Kans. 66935	Stationary	Clay, Republic.
Carlile Sand & Gravel	Liberal, Kans. 67901	Portable	Seward.
Consumers Sand Co.	Topeka, Kans. 66608	Portable and dredge	Shawnee.
Dodge City Sand Co.	Dodge City, Kans. 67801	Dredge	Ford.
Dolese Bros. Co.	Oklahoma City, Okla. 73103	Stationary	Sedgwick.
Holliday Sand & Gravel Co.	Overland Park, Kans 66202	Stationary and portable.	Douglas, Johnson, Wyandotte.
Miles Sand Co.	Wichita, Kans. 67204	Stationary	Sedgwick.
Peck-Woolf Sand & Material Co	Kansas City, Kans. 66111	Dredge	Wyandotte.
P & K Sand Co.	Garden City, Kans. 67846	Stationary	Finney.
Salina Sand Co.	Mentor, Kans. 67465	Stationary and portable.	Saline.
San Ore Constr. Co.	McPherson, Kans. 67460	Portable	McPherson, Mitchell, Rooks, Thomas.
Shoffner Sand, Inc.	Salina, Kans. 67401	do	Douglas.
Siebert Sand Co., Inc.	Ness City, Kans. 67560	do	Various.
Stewart Sand & Material Co.	Kansas City, Kans. 66108	Stationary	Wyandotte.
Superior Sand Co., Inc.	Wichita, Kans. 67212	Dredge	Sedgwick.
J. A. Tobin Cont. Co.	Kansas City, Kans. 66103	Portable	Wyandotte.
Victory Sand & Concrete Co.	Topeka, Kans. 66601	Dredge	Shawnee.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone:			
Anderson-Oxandale Co	Herington, Kans. 67449	Quarry	Chase, Clay, Coffey, Dickinson, Geary, Jackson, Jewell, Marion, Morris, Ness, Pottawatomie, Rawlins, Riley, Smith.
Ash Grove Cement Co	Kansas City, Mo. 64105	do	Neosho.
H. J. Born Stone Co	Wichita, Kans. 67204	do	Chase, Cowley.
Cullor Limestone Co., Inc	Fort Scott, Kans. 66701	do	Bourbon.
General Portland Cement Co	Dallas, Texas 75201	do	Wilson.
Hallett Const. Co	Crosby, Minn. 56441	do	Chase, Clay, Dickinson, McPherson, Marion, Rice.
N. R. Hamm Quarry, Inc	Perry, Kans. 66073	do	Jefferson, Leavenworth, Shawnee.
Holland Quarries	Lenexa, Kans. 66215	do	Johnson.
Ideal Cement Co	Denver, Colo. 80202	do	Jewell.
Lehigh Portland Cement Co	Allentown, Pa. 18105	do	Allen.
Lone Star Cement Corp	Indianapolis, Ind. 46205	do	Wyandotte.
Martin-Marietta Corp. Concrete Materials Div.	Cedar Rapids, Iowa 52406	do	Atchison, Elk, Franklin.
Midwest Minerals, Inc	Girard, Kans. 66743	do	Various.
Monarch Cement Co	Humboldt, Kans. 66748	do	Allen.
Nelson Bros. Quarries	La Harpe, Kans. 66751	do	Allen, Montgomery, Woodson, Various.
George M. Myers, Inc	El Dorado, Kans. 67042	do	Butler.
Quartzite Stone Co., Inc	Lincoln, Kans. 67455	do	Lincoln.
Reno Construction Co	Overland Park, Kans. 66204	do	Johnson.
Thompson-Strauss Quarries	Kansas City, Kans. 66106	do	Wyandotte.
Union Quarries, Inc	Overland Park, Kans. 66204	do	Johnson.
Universal Atlas Cement Co. Div. of U. S. Steel Corp.	Pittsburgh, Pa. 15230	do	Montgomery.
Walker Stone Co	Chapman, Kans. 67481	do	Dickinson.
Helium:			
Alamo Chemical Co.-Gardner Cryogenics, Inc.	Elkhart, Kans. 67950	Plant	Morton.
Cities Service Cryogenics, Inc	Scott City, Kans. 67871	do	Scott.
Cities Service Helex, Inc	Ulysses, Kans. 67880	do	Grant.
Kansas Refined Helium Co	Otis, Kans. 67565	do	Rush.
National Helium Corp	Liberal, Kans. 67901	do	Seward.
Northern Helex Co	Bushton, Kans. 67427	do	Ellsworth.
Petroleum Operators:			
Cities Service Oil Co	Tulsa, Okla. 74100		Various.
Continental Oil Co	New York City, N.Y. 10000		Do.
National Cooperative Refinery Association.	McPherson, Kans. 67460		Do.
Pan American Petroleum Corp	Tulsa, Okla. 74100		Do.
Skelly Oil Co	do		Do.
Sun Oil Co	Philadelphia, Pa. 19100		Do.
Texaco Inc	New York City, N.Y. 10000		Do.
Petroleum Refineries:			
American Oil Co	Neodesha, Kans. 66757	Refinery	Wilson.
American Petrofina Co. of Texas.	El Dorado, Kans. 67042	do	Butler.
Apco Oil Corp	Arkansas City, Kans. 67005	do	Cowley.
Century Refining Co	Scott City, Kans. 67871	do	Scott.
CRA, Inc	Coffeyville, Kans. 67337	do	Montgomery.
	Phillipsburg, Kans. 67661	do	Phillips.
Derby Refining Co	Wichita, Kans. 67200	do	Sedgwick.
Mid-American Refining Co., Inc.	Chanute, Kans. 66720	do	Neosho.
Mobil Oil Corp	Augusta, Kans. 67010	do	Butler.
National Cooperative Refinery Association.	McPherson, Kans. 67460	do	McPherson.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Petroleum Refineries—Continued			
Phillips Petroleum Co	Kansas City, Kans. 66100	Refinery	Wyandotte.
Skelly Oil Co	El Dorado, Kans. 67042	do	Butler.
Natural Gas Purchasers:			
Cities Service Gas Co	Okla. City, Okla. 73100		Various.
Colorado Interstate Gas Co	Colorado Springs. Colo. 80900.		Do.
Kansas-Nebraska Natural Gas Co.	Hastings, Nebr. 68901		Do.
Northern Natural Gas Co	Omaha, Nebr. 68100		Do.
Panhandle Eastern Pipeline Co.	Houston, Tex. 77000		Do.

The Mineral Industry of Kentucky

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Kentucky for collecting information on all minerals except fuels.

By H. L. Riley [1] and Preston McGrain [2]

Mineral production value in Kentucky decreased less than 1 percent in 1968 from the 1967 record year. Kentucky ranked second in the United States in production of bituminous coal with 19 percent of the national total, and second in production of ball clay and fluorspar.

In 1968, coal production was 74 percent of the State's total value of mineral production, the same as in 1967.

Legislation and Government Programs.— The U.S. Geological Survey and the Kentucky Geological Survey continued their cooperative program of mapping the geology of the State on 7.5-minute quadrangles. At yearend, 321 geologic maps covering parts of or all of the 340 quadrangles had been published. The Kentucky Geological Survey published five reports relating to mineral resources.[3]

Table 1.—Mineral production in Kentucky[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] .... thousand short tons..	1,195	$2,066	1,219	$1,952
Coal (bituminous) .... do....	100,294	396,883	101,156	395,039
Fluorspar .... short tons..	32,952	1,686	17,050	878
Lead (recoverable content of ores, etc.) .... do....	845	237	W	W
Natural gas .... million cubic feet..	89,168	21,400	89,024	22,256
Petroleum (crude) .... thousand 42-gallon barrels..	15,535	45,052	14,036	41,125
Sand and gravel .... thousand short tons..	7,981	7,859	7,478	8,081
Silver (recoverable content of ores, etc.) .... troy ounces..	568	1	---------	---------
Stone .... thousand short tons..	24,812	35,481	30,105	43,266
Zinc (recoverable content of ores, etc.) .... short tons..	6,317	1,749	W	W
Value of items that cannot be disclosed: Native asphalt, ball clay, cement, natural gas liquids, and values indicated by symbol W	XX	23,291	XX	22,266
Total	XX	535,705	XX	534,863
Total 1957-59 constant dollars	XX	r 569,127	XX	p 546,092

p Preliminary. r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes ball clay, included with "Value of items that cannot be disclosed."

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[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.

[2] Assistant State geologist, Kentucky Geological Survey, Lexington, Ky.

[3] Finch, Warren I. Engineering Geology of the Calvert City Quadrangle, Livingston and Marshall Counties, Kentucky. Kentucky Geol. Survey, Ser. X, Inf. Cir. 15, 1968, 28 pp.

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Rose, William D. (ed.). Proceedings of the Technical Sessions Kentucky Oil and Gas Association, Thirtieth and Thirty-First Annual Meetings, 1966 and 1967. Kentucky Geol. Survey, Inf. Cir. 16, 1968, 28 pp.

Table 2.—Value of mineral production in Kentucky, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value[2]
Adair	W	W	Limestone, petroleum.
Allen	W	W	Petroleum, limestone.
Anderson	W	W	Limestone.
Ballard	$20	$13	Sand and gravel.
Barren	W	977	Limestone, petroleum.
Bath	11	9	Petroleum.
Bell	9,686	10,334	Coal.
Boone	1,707	985	Sand and gravel.
Bourbon	W	W	Limestone.
Boyd	W	W	Coal, miscellaneous clay, petroleum.
Boyle	W	W	Limestone.
Breathitt	6,825	5,410	Coal, petroleum.
Breckinridge	W	483	Limestone, sand and gravel, petroleum.
Bullitt	W	886	Limestone, miscellaneous clay.
Butler	W	W	Coal, petroleum, limestone.
Caldwell	W	W	Limestone.
Calloway	W	W	Sand and gravel, limestone.
Carlisle	16	12	Sand and gravel.
Carter	1,541	1,587	Limestone, fire clay, coal.
Casey	W	224	Limestone, petroleum.
Christian	W	3,179	Limestone, petroleum, miscellaneous clay.
Clay	2,957	2,706	Coal, petroleum.
Clinton	W	337	Petroleum, coal, limestone.
Crittenden	W	W	Limestone, fluorspar.
Cumberland	W	W	Petroleum, limestone.
Daviess	W	W	Petroleum, coal, sand and gravel, miscellaneous clay.
Edmonson	W	W	Limestone, native asphalt, petroleum.
Elliott	141	173	Petroleum, coal.
Estill	W	W	Petroleum, limestone.
Fayette	W	W	Limestone.
Fleming	W	W	Do.
Floyd	W	26,118	Coal, petroleum, sand and gravel.
Franklin	W	W	Limestone.
Fulton	16	7	Sand and gravel.
Gallatin	W	W	Do.
Garrard	W	109	Limestone.
Graves	W	W	Ball clay, sand and gravel.
Grayson	W	W	Limestone.
Green	W	W	Petroleum, limestone.
Greenup	W	453	Fire clay, limestone, petroleum.
Hancock	616	516	Petroleum, miscellaneous clay, fire clay.
Hardin	1,170	1,601	Limestone.
Harlan	W	36,747	Coal, limestone.
Harrison	W	W	Limestone.
Hart	W	245	Petroleum, limestone.
Henderson	W	8,502	Petroleum, sand and gravel, coal.
Henry	W	W	Limestone.
Hickman	16	1	Sand and gravel.
Hopkins	46,385	43,301	Coal, petroleum, miscellaneous clay.
Jackson	W	201	Limestone, coal, petroleum.
Jefferson	W	13,812	Cement, limestone, sand and gravel, miscellaneous clay.
Jessamine	W	W	Limestone.
Johnson	2,867	5,210	Coal, petroleum.
Knott	7,163	8,270	Do.
Knox	W	579	Do.
Laurel	W	W	Limestone, coal, petroleum.
Lawrence	1,280	W	Petroleum, coal.
Lee	W	W	Petroleum, limestone, coal.
Leslie	6,800	8,021	Coal, petroleum.
Letcher	W	29,568	Coal, limestone, petroleum.
Lincoln	3	---------	
Livingston	W	6,686	Limestone, zinc, fluorspar, sandstone, lead, sand and gravel.
Logan	W	W	Limestone, petroleum.
Lyon	12	5	Sand and gravel.
McCracken	W	W	Do.
McCreary	2,134	W	Coal, petroleum.
McLean	2,939	2,391	Petroleum.
Madison	W	W	Limestone.
Magoffin	W	2,030	Petroleum, coal.
Marion	W	W	Limestone, petroleum.
Marshall	42	15	Sand and gravel.
Martin	1,961	2,813	Coal, sand and gravel, petroleum.
Mason	W	165	Sand and gravel.
Meade	W	W	Limestone.
Menifee	W	W	Do.
Mercer	W	W	Do.

See footnotes at end of table.

Table 2.—Value of mineral production in Kentucky, by counties[1]—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value [2]
Metcalfe	W	W	Petroleum, limestone.
Monroe	$340	$393	Limestone, petroleum.
Montgomery	W	80	Limestone.
Morgan	W	777	Limestone, coal, fire clay, petroleum.
Muhlenberg	W	71,589	Coal, petroleum, limestone.
Nelson	W	W	Limestone.
Nicholas	79	W	Do.
Ohio	W	W	Coal, petroleum, limestone.
Oldham	W	1,666	Limestone.
Owsley	2	1	Petroleum.
Pendleton	W	W	Limestone.
Perry	21,943	18,033	Coal, petroleum.
Pike	W	78,693	Coal, petroleum, limestone.
Powell	W	W	Limestone, petroleum, miscellaneous clay.
Pulaski	1,871	2,423	Coal, limestone, petroleum.
Rockcastle	W	W	Limestone.
Rowan	W	1,589	Limestone, fire clay, miscellaneous clay.
Russell	4	2	Petroleum.
Scott	W	W	Limestone.
Simpson	W	W	Limestone, petroleum.
Taylor	W	W	Do.
Todd	W	W	Do.
Trigg	W	224	Limestone.
Trimble	W	W	Sand and gravel.
Union	W	21,732	Coal, petroleum, sand and gravel.
Warren	909	880	Limestone, petroleum.
Wayne	W	W	Limestone, coal, petroleum.
Webster	7,928	9,671	Coal, petroleum.
Whitley	1,167	1,480	Coal, petroleum, miscellaneous clay.
Wolfe	W	W	Limestone, petroleum.
Undistributed [3]	405,153	100,949	
Total [4]	535,705	534,863	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Bracken, Campbell, Carroll, Clark, Grant, Kenton, Larue, Lewis, Owen, Robertson, Shelby, Spencer, Washington, and Woodford.

[2] Excludes natural gas and natural gas liquids; included in "Undistributed."

[3] Includes natural gas, natural gas liquids, and values indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

The U.S. Geological Survey published two bulletins on engineering geology in cooperation with the Kentucky Geological Survey.[4]

The Bureau of Mines published two reports pertaining to the mineral industry of Kentucky.[5]

Economic Indicators.—Personal per capita income increased 7 percent, and the total number of unemployed decreased 12 percent. Farm marketing receipts as well as farm employment decreased 6 percent. Mineral production value and employment declined slightly. Portland cement shipments increased 21 percent. New business incorporations increased 11 percent. Total sales of electric energy increased 7 percent. Construction of housing units increased nearly 8 percent, but private nonresidential construction dropped sharply.

Trends and Developments.—The Western Kentucky Division of Island Creek Coal Co. dedicated its new Hamilton Mine in Union County. Planned capacity when fully developed is 5 million tons per year.

Pittsburgh & Midway Coal Co.'s DeKoven No. 9 mine in Union County was closed as a result of a fire and unfavorable natural conditions.

At the Tennessee Valley Authority's Paradise steam-electric generating plant, one of the three 437-foot cooling water towers supplementing the cooling capacity of the Green River, was placed in operation. One of the plant's 700,000-kilowatt units will test the feasibility of the dry limestone injection process of reducing the quantity of sulfur dioxide discharged from the unit's stack.

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[4] Finch, Warren I. Engineering Geology of the Paducah West and Metropolis Quadrangles in Kentucky. U.S. Geol. Survey, Bull. 1258–B, 1968, 19 pp.

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[5] Danielson, V. A., and D. H. White. Waste Disposal Costs at Two Mines in Kentucky and Alabama. BuMines Inf. Circ. 8406, 1968, 28 pp.

Hollenbeck, Ronald P., and M. E. Tyrrell. Shales for Lightweight Aggregate in Appalachian Region, Kentucky and Tennessee. BuMines Rept. of Inv. 7129, 1968, 54 pp.

Table 3.—Selected economic indicators of Kentucky business activity

	1967	1968	Change (percent)
Employment and labor force, annual average:			
Total work force available thousands	1,136	1,141	+0.4
Total unemployed do	48	42	−12.5
Employment:			
Agricultural do	130	122	−6.2
Nonagricultural do	835	853	+2.2
Mining do	28	27	−3.6
Contract construction do	48	51	+6.2
Service do	113	116	+2.7
Government do	156	160	+2.6
Manufacturing do	230	232	+.9
Personal income:			
Total millions	[r] $7,737	[p] $8,363	+8.1
Per capita	[r] $2,417	[p] $2,597	+7.4
New business incorporations	2,517	2,802	+11.3
Construction activity:			
Housing units—private and public	14,446	15,547	+7.6
Total private nonresidential construction millions	$112.2	$83.0	−26.0
Cement shipments to and within Kentucky:			
Portland (includes high early strength) thousand 376-pound barrels	5,983	7,250	+21.2
Masonry thousand 280-pound barrels	575	632	+9.9
Farm marketing receipts thousands	$820,861	$771,971	−6.0
Mineral production millions	$536	$535	−.2
Total sales of electric energy: To ultimate consumers million kilowatt-hours	28,691	30,822	+7.4

[r] Revised. [p] Preliminary.

Sources: U.S. Department of Commerce, Kentucky Department of Labor, Kentucky Department of Economic Security, and Edison Electric Institute.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	24,218	192	4,646	36,890	52	1,660	46.41	10,358
Metal	40	282	11	90	-------	15	166.25	2,888
Nonmetal	366	237	87	698	-------	37	53.40	1,533
Sand and gravel	412	250	103	1,001	-------	23	22.99	817
Stone	2,052	247	507	4,205	3	112	27.35	5,296
Total	27,088	198	5,354	42,879	55	1,847	44.36	9,480
1968:[p]								
Coal	23,000	192	4,414	34,900	58	1,475	43.92	11,746
Metal	65	282	19	151	1	15	106.08	41,101
Nonmetal	295	229	67	537	-------	19	35.39	7,947
Sand and gravel	285	271	78	729	-------	32	43.90	9,342
Stone	2,140	248	530	4,389	7	142	33.95	10,463
Total [1]	25,740	198	5,108	40,708	66	1,683	42.96	11,628

[p] Preliminary.

[1] Data may not add to totals shown because of independent rounding.

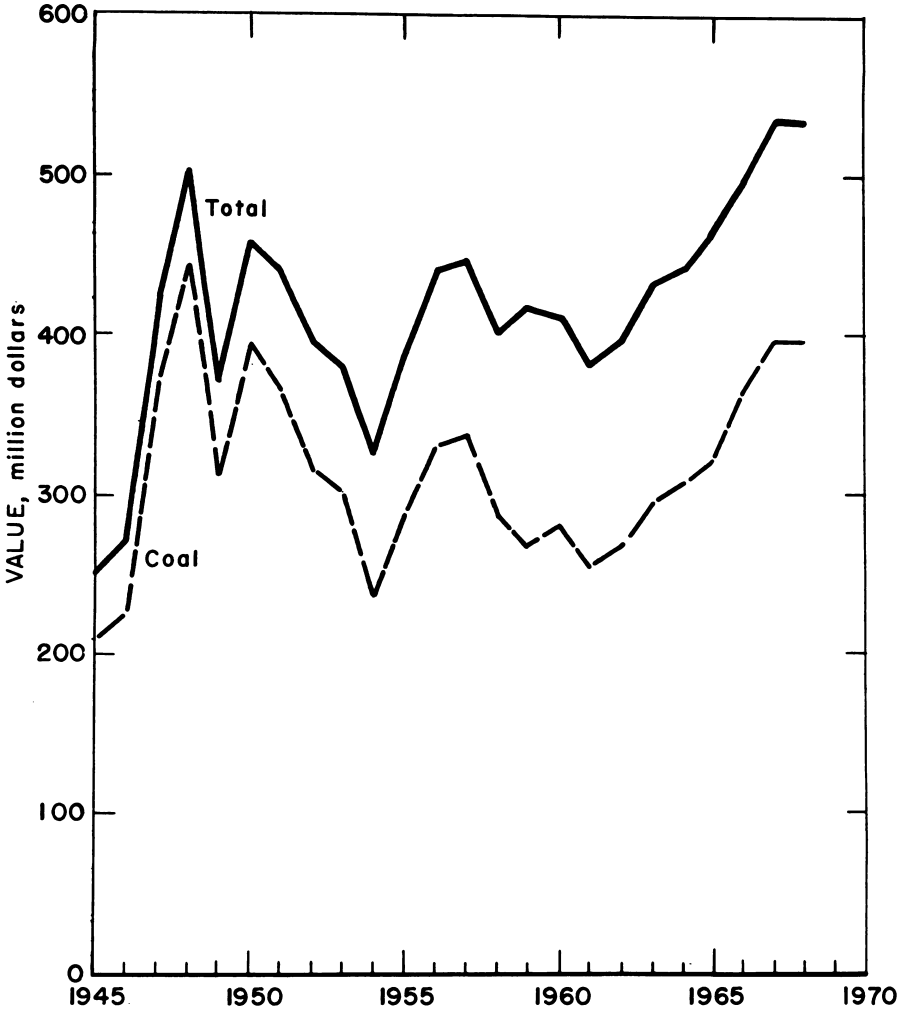

Figure 1.—Value of coal and total value of mineral production in Kentucky.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The combined value of bituminous coal, natural gas, and crude petroleum production was $458 million, 86 percent of the total mineral production of the State.

Coal (Bituminous).—Production of coal increased 1 percent above that of 1967, the record year, but its value $395 million, was 11 percent below that of 1948, the record year for value. The reduction in value reflects the increase in the percentage of the relatively low valued coals used in steam-electric generating plants and the decrease in use of the higher valued, sized, domestic grades of coal.

Table 5.—Coal (bituminous) production[1] in 1968, by counties

(Thousand short tons and thousand dollars)

County	Number of mines in operation			Production[2]				
	Underground	Strip	Auger	Underground	Strip	Auger	Total	
							Quantity	Value
Bell	31	17	17	966	1,473	805	3,244	$10,334
Boyd	-------	1	-------	-------	W	-------	W	W
Breathitt	2	8	5	W	1,279	W	1,720	5,326
Butler	2	3	-------	W	W	-------	152	554
Carter	3	-------	-------	W	-------	-------	W	W
Clay	24	1	3	W	W	W	642	2,688
Clinton	4	-------	-------	25	-------	-------	25	W
Daviess	-------	2	-------	-------	W	-------	W	W
Elliott	-------	3	-------	-------	10	-------	10	46
Floyd	154	3	3	4,248	W	W	4,609	W
Harlan	87	11	16	6,090	362	453	6,905	W
Henderson	4	-------	-------	195	-------	-------	195	W
Hopkins	14	12	3	W	W	W	12,087	40,580
Jackson	1	1	-------	W	W	-------	W	25
Johnson	21	2	-------	W	W	-------	688	3,786
Knott	63	3	15	1,704	220	373	2,297	8,242
Knox	43	1	1	137	7	10	153	574
Laurel	1	-------	-------	10	-------	-------	10	37
Lawrence	-------	-------	2	-------	-------	W	W	W
Lee	3	-------	-------	W	-------	-------	W	W
Leslie	30	1	1	1,665	38	38	1,740	8,012
Letcher	152	8	11	5,070	606	196	5,871	W
McCreary	8	-------	-------	W	-------	-------	W	W
Magoffin	1	2	3	W	W	W	388	784
Martin	4	-------	-------	W	-------	-------	W	W
Morgan	1	2	-------	W	W	-------	18	107
Muhlenberg	7	11	-------	3,466	17,177	-------	20,643	W
Ohio	2	9	2	W	W	W	W	W
Perry	54	11	24	2,353	696	1,266	4,316	17,951
Pike	362	4	44	17,675	W	W	19,619	W
Pulaski	3	1	-------	W	W	-------	491	W
Union	5	-------	-------	W	-------	-------	W	W
Wayne	-------	-------	1	-------	-------	W	W	W
Webster	4	4	-------	W	W	-------	2,160	7,058
Whitley	31	2	-------	399	11	-------	409	W
Undistributed[3]	-------	-------	-------	16,691	12,355	3,087	[4] 12,760	288,982
Total	1,121	123	151	60,694	34,233	6,229	101,156	395,089

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Excludes mines producing less than 1,000 short tons.

[2] Data may not add to totals shown because of independent rounding.

[3] Includes counties indicated by symbol W.

[4] Does not equal the sum of undistributed underground, strip and auger because some county totals are publishable.

Bituminous coal was produced at 1,395 mines in 35 counties, compared with 1,532 mines in 37 counties in 1967. Leading producing counties on the basis of production were Muhlenberg, Pike, Hopkins, Harlan, and Ohio.

In the Eastern Kentucky coalfield, 1,311 mines in 27 counties produced 55 million tons compared with 1,454 mines in 27 counties and a production of 54 million tons in 1967. Underground mines produced 78 percent of the total; auger mines and strip mines 11 percent each. Shipments were 95 percent by rail or water, and 5 percent by truck. Eleven percent of the tonnage was captive.

Equipment used at 1,083 Eastern Kentucky underground mines included 704 cutting machines, which cut 65 percent of the coal mined underground; 1,262 power drills, which drilled 75 percent of the tonnage; and 537 mobile loading machines, which mechanically loaded 62 percent of the tonnage. One hundred and five continuous miners, used in conjunction with six mobile loaders, mined and loaded 24 percent of the coal mined underground. Underground mine haulage equipment included 347 locomotives, 597 shuttle cars, 437 shuttle buggies, 896 rubber-tired tractors, and 235 gathering conveyors.

The equipment used at 82 strip mines included 113 power shovels; the dipper capacity of five of these shovels was in the 6 to 12 cubic yard range, 21 were in the 3- to 5-cubic-yard range, and the remainder had a capacity of less than 3 cubic yards. In addition, two draglines were reported in use, and one of these was of 6- to 12-cubic-yard capacity. Forty-four power drills and 154 trucks were used.

In eastern Kentucky 145 augers mined coal at 146 locations. Auxiliary equipment included two power shovels, 96 bulldozers, and four power drills.

Of the total coal produced from the Eastern Kentucky field, 26 percent was crushed, 30 percent was cleaned at 36 coal cleaning plants, and 10 percent was treated with oil or other materials to allay the coal dust.

In the Western Kentucky coalfield, 84 mines in eight counties produced 46.5 million tons of coal, compared with 78 mines in 10 counties, and 46 million tons in 1967. Strip mines produced 61 percent of the coal, underground mines 38 percent, and auger mines less than 1 percent of the tonnage. Shipments were 86 percent by rail or water, and 14 percent by truck. All coal was sold on the open market. In the 38 underground mines, equipment included 101 cutting machines, 102 power drills, 100 mobile loading machines, and three continuous mining machines. Equipment used at 41 strip mines included 72 power shovels, of which 16 had a capacity greater than 12 cubic yards. Thirty-five draglines stripped overburden; 17 of these had a capacity greater than 12 cubic yards. Other equipment included 133 bulldozers, one carryall scraper, 56 power drills, and 232 trucks. Of these trucks, 124 had a capacity of 30 tons or more, and 13 had a capacity of 120 tons. Five coal augers and three bulldozers were in use at five auger mines.

In the Western Kentucky coalfield, 64 percent of the coal was cleaned in 21 coal preparation plants. Eighty-seven percent of the total coal produced was crushed, and 19 percent treated with oil or chemicals to reduce dust.

Natural Gas.[6]—Marketed production of natural gas was substantially the same as in 1967, but was 8.0 percent below the 1947 record. Most of the gas production came from the eastern portion of the State. At yearend, 6,470 wells were estimated to be in production.

Natural Gas Liquids.—Production of natural gasoline increased 2 percent, and that of liquefied petroleum gases (LPG) decreased 11 percent.

Petroleum.[7]—Crude oil production of 14.0 million barrels was 1.5 million barrels less than in 1967. This decrease reflects the effect of normal decline in production rates of producing wells and lower drilling activity. Of the State's 120 counties, 59 counties contributed to the year's petroleum production. Union County, in western Kentucky, was the leading producing county in the State with 2.3 million barrels, and Lee County led all eastern Kentucky counties with 1.7 million barrels.

The Kentucky Geological Survey reported 1,556 wells drilled during 1968: 600 wells were completed as oil or gas wells; 693 wells were dry holes, and 263 wells were drilled for miscellaneous purposes such as gas storage, water injection, and stratigraphic tests.

NONMETALS

Nonmetals provided 12 percent of the total value of mineral production in the State.

Cement.—One cement plant continued in production. Shipments of portland cement decreased 4 percent; they were 10 percent below the 1963 record. The major portion of the cement was shipped to ready mix plants in Kentucky; most shipments were made by truck. Masonry cement shipments increased 16 percent, establishing a new record, with most of the shipments made to Kentucky and Indiana. Raw materials used in portland cement manufacture included limestone (75 percent), miscellaneous clay (21 percent), gypsum (3 percent), and iron ore (1 percent).

Clays.—Kentucky ranked second in the United States in ball clay production. Ball clay was mined by three companies from four open pit mines in Graves County.

Total fire clay production was 196,000 tons valued at $950,000, or 36 percent more tonnage than in 1967. Twelve companies mined fire clay at 26 open-pit mines in Carter, Greenup, and Rowan Counties. Most of the clay was used in production

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[6] Prepared in cooperation with E. N. Wilson, Head, Oil and Gas Section, Kentucky Geological Survey.

[7] Prepared in cooperation with E. N. Wilson, Head, Oil and Gas Section, Kentucky Geological Survey.

Table 6.—Crude petroleum production by counties

(Thousand 42-gallon barrels and thousand dollars)

County	1967		1968	
	Quantity	Value	Quantity	Value
Adair	(1)	$1	(1)	$1
Allen	62	181	62	183
Barren	15	44	16	47
Bath	4	11	3	9
Bell	(1)	(1)	----------	----------
Boyd	4	12	2	6
Breathitt	35	101	29	85
Breckinridge	25	74	18	52
Butler	75	219	69	202
Casey	7	21	15	44
Christian	240	696	199	584
Clay	14	40	6	18
Clinton	56	163	50	147
Crittenden	(1)	(1)	----------	----------
Cumberland	38	110	37	107
Daviess	1,258	3,648	1,251	3,665
Edmonson	1	3	1	2
Elliott	45	130	43	127
Estill	256	743	302	884
Floyd	27	79	39	114
Green	192	558	143	420
Greenup	1	4	5	15
Hancock	111	323	89	260
Hart	32	94	21	63
Henderson	2,678	7,768	2,252	6,599
Hopkins	966	2,801	945	2,769
Jackson	(1)	(1)	(1)	(1)
Johnson	570	1,653	486	1,424
Knott	12	36	10	28
Knox	2	5	2	5
Laurel	4	11	4	12
Lawrence	436	1,264	362	1,062
Lee	1,793	5,200	1,668	4,888
Leslie	3	9	3	8
Letcher	33	95	113	330
Lincoln	1	3	----------	----------
Logan	(1)	1	1	3
McCreary	2	7	2	7
McLean	1,014	2,939	816	2,391
Magoffin	492	1,427	425	1,246
Marion	----------	----------	(1)	(1)
Martin	14	40	12	34
Menifee	1	3	----------	----------
Metcalfe	139	408	118	345
Monroe	64	184	29	85
Morgan	1	4	1	4
Muhlenberg	544	1,577	491	1,440
Ohio	584	1,698	514	1,505
Owsley	1	2	1	1
Perry	19	56	28	82
Pike	30	86	32	93
Powell	75	217	58	170
Pulaski	1	3	3	8
Russell	1	4	1	2
Simpson	6	16	6	19
Taylor	1	3	1	3
Todd	(1)	1	1	2
Union	2,443	7,086	2,291	6,713
Warren	27	79	22	65
Wayne	26	76	16	47
Webster	1,021	2,961	892	2,612
Whitley	16	47	20	58
Wolfe	13	39	10	28
Total [2]	15,535	45,052	14,036	41,125
Earliest record to date	544,434	1,306,924	558,470	1,348,049

[1] Less than ½ unit.

[2] Data may not add to totals shown because of independent rounding.

Source: Kentucky Geological Survey.

Table 7.—Oil and gas well drilling in 1968

County	Development wells				Exploratory wells			
	Oil	Gas	Dry	Footage	Oil	Gas	Dry	Footage
Adair	-----	-----	2	502	1	-----	16	6,472
Allen	8	-----	8	5,916	1	-----	9	4,409
Barren	8	1	5	4,736	3	1	24	14,114
Bath	-----	-----	1	400	-----	-----	3	1,153
Boyd	-----	1	1	6,225	-----	1	3	21,524
Breathitt	-----	11	-----	19,858	-----	3	-----	5,348
Breckinridge	-----	-----	3	1,030	-----	-----	1	520
Butler	4	-----	7	4,842	-----	-----	8	3,622
Caldwell	-----	-----	-----	----------	-----	-----	3	7,506
Carter	-----	-----	-----	----------	-----	-----	1	2,049
Casey	4	-----	3	4,733	3	-----	14	11,458
Christian	2	-----	6	5,155	1	-----	6	8,808
Clay	-----	29	16	50,267	-----	3	7	11,651
Clinton	9	-----	5	10,366	2	-----	6	8,149
Crittenden	-----	-----	-----	----------	-----	-----	2	3,150
Cumberland	9	-----	4	4,013	4	-----	16	11,933
Daviess	59	1	52	156,592	2	-----	17	30,957
Edmonson	-----	-----	1	825	-----	-----	1	1,000
Elliott	4	-----	-----	3,249	3	-----	1	4,645
Estill	1	-----	-----	208	1	-----	4	2,360
Floyd	1	8	1	22,612	-----	2	2	8,109
Garrard	-----	-----	-----	----------	-----	-----	1	5,740
Graves	-----	-----	-----	----------	-----	-----	2	3,467
Green	22	-----	10	15,469	4	1	4	7,123
Greenup	-----	2	-----	3,348	2	1	1	3,386
Hancock	7	-----	15	12,625	1	-----	5	4,747
Hart	3	1	-----	2,545	1	-----	3	3,616
Henderson	8	-----	19	52,944	-----	-----	7	17,210
Hopkins	17	11	23	115,431	4	3	30	81,655
Jessamine	-----	-----	-----	----------	-----	-----	1	6,072
Johnson	-----	3	-----	7,178	-----	-----	-----	----------
Knott	-----	3	1	11,164	1	-----	1	5,872
Knox	-----	13	1	22,268	-----	1	2	8,927
Laurel	-----	2	1	2,991	-----	-----	2	2,405
Lawrence	11	4	2	24,754	2	4	-----	14,003
Lee	30	-----	-----	30,374	-----	-----	-----	----------
Leslie	-----	-----	-----	----------	-----	-----	1	3,612
Letcher	1	14	3	53,187	-----	6	1	24,277
Lewis	-----	-----	-----	----------	-----	-----	3	11,045
Lincoln	-----	-----	-----	----------	-----	-----	1	360
Logan	-----	-----	-----	----------	1	-----	-----	1,072
McCreary	-----	-----	-----	----------	-----	-----	2	1,536
McLean	6	-----	25	50,300	2	-----	14	34,369
Madison	-----	-----	-----	----------	-----	-----	1	160
Magoffin	26	1	-----	29,335	-----	1	-----	480
Marion	-----	-----	-----	----------	-----	-----	1	1,881
Martin	-----	7	1	15,195	-----	1	-----	3,073
Menifee	-----	-----	-----	----------	-----	-----	1	867
Metcalfe	13	1	22	10,779	1	-----	35	16,245
Monroe	3	-----	7	4,345	-----	-----	27	17,093
Morgan	-----	1	-----	1,835	-----	1	-----	1,825
Muhlenberg	9	2	12	24,110	1	-----	6	9,403
Ohio	16	-----	36	38,897	1	-----	9	10,959
Owsley	-----	-----	-----	----------	-----	-----	3	5,833
Perry	1	28	1	104,176	1	3	1	14,934
Pike	-----	21	2	78,148	-----	1	-----	3,598
Powell	4	-----	-----	3,869	1	-----	-----	850
Russell	1	-----	-----	208	-----	-----	3	2,699
Shelby	-----	-----	-----	----------	-----	-----	1	1,510
Simpson	-----	-----	-----	----------	-----	-----	1	1,637
Spencer	-----	-----	-----	----------	-----	-----	1	1,540
Taylor	4	-----	2	3,210	-----	-----	-----	----------
Todd	-----	-----	-----	----------	-----	-----	2	2,042
Union	29	-----	15	78,402	1	-----	12	28,327
Warren	1	-----	-----	605	-----	-----	9	7,254
Wayne	4	-----	5	7,692	1	-----	12	9,888
Webster	7	-----	6	32,461	1	-----	6	21,658
Whiteley	3	5	3	11,496	-----	2	7	11,996
Wolfe	-----	1	-----	2,014	-----	-----	1	1,400
Woodford	-----	-----	-----	----------	-----	-----	1	2,812
Total	335	171	327	1,147,869	47	35	365	593,895

Source: American Association of Petroleum Geologists.

of firebrick with smaller quantities used in floor and wall tile and other refractories.

Miscellaneous clay was mined by 14 companies from 16 open-pit mines in 10 counties. Production decreased 3 percent below that of 1967, the record year, and totaled 1.0 million tons valued at $1.0 million. The majority of the clay was used to make lightweight aggregate and building brick with smaller tonnages used in portland cement and draintile.

Fluorspar.—Fluorspar was mined in Livingston and Crittenden Counties by six companies at five underground and four open-pit mines. Shipments were 17,000 tons valued at $900,000, a decline of 48 percent in both quantity and value from that of the previous year. The decline reflects in part the depletion of reserves of the Dyers Hill mine. Most of the fluorspar was used in the manufacture of hydrofluoric acid.

Lime.—Lime was regenerated by calcining sludge at two plants, one each in Marshall and Jefferson Counties.

Perlite.—Perlite mined in Western States was expanded at plants in Boone and Campbell Counties. The perlite was used mainly in industrial board, soil conditioning, and building plaster.

Sand and Gravel.—Sand and gravel was mined by 21 producers, including State and County Highway Departments, at 32 operations in 21 counties. Sixteen dredges were in operation recovering sand and gravel. Leading counties were Jefferson, Trimble, and Boone. Production and shipments decreased 6 percent. The end uses were structural sand, 37 percent; paving sand, 19 percent; fill sand, 19 percent, structural gravel, 10 percent, and other uses 15 percent. Transportation was 67 percent by truck, 25 percent by waterway, and 8 percent by rail.

Table 8.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1967			1968		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Ballard	1	35	$20	1	13	$13
Boone	4	1,819	1,707	3	971	985
Calloway	2	188	120	2	W	W
Carlisle	1	29	16	1	11	12
Fulton	1	31	16	1	6	7
Graves	1	63	32	1	68	72
Hickman	1	32	16	1	1	1
Jefferson	4	2,191	2,361	5	2,669	2,521
Livingston	1	30	15	1	6	7
Lyon	1	24	12	1	5	5
Marshall	1	35	42	1	14	15
Martin	1	19	19	1	34	W
Mason	2	W	W	2	W	165
Union	2	W	W	3	299	W
Other counties [1]	10	3,485	3,483	8	3,381	4,278
Total	33	7,981	7,859	32	7,478	8,081

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."

[1] Includes Breckinridge, Daviess, Floyd, Gallatin, Henderson, McCracken, and Trimble Counties, and counties indicated by symbol W.

Table 9.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967 Quantity	1967 Value: Total	1967 Value: Average per ton	1968 Quantity	1968 Value: Total	1968 Value: Average per ton
SAND						
Structural	2,496	$2,553	$1.02	2,733	$2,869	$1.05
Paving	2,218	2,098	.95	1,390	1,433	1.08
Fill	741	415	.56	1,449	1,182	.78
GRAVEL						
Structural	817	1,007	1.23	755	940	1.25
Paving	1,494	1,602	1.07	W	W	W
Fill	W	W	W	154	189	.90
Railroad ballast	W	W	W	39	55	1.41
Total sand and gravel [1]	7,981	7,859	.98	7,478	8,081	1.08

W Withheld to avoid disclosing confidential data; included with "Total sand and gravel."

[1] Includes blast (1968), engine, foundry (1968) and other sands; other gravel and uses indicated by symbol W.

Stone.—Eighty-three producers crushed limestone at 118 operations in 67 counties. Twenty-three of the mines were underground. The leading producing counties were Livingston, Christian, and Jefferson. Shipments of crushed limestone increased 21 percent. The end uses included 78 percent for use in concrete and roads, and 7 percent for aglime, and 15 percent for other uses.

Table 10.—Crushed limestone sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1967 Number of quarries	1967 Quantity	1967 Value	1968 Number of quarries	1968 Quantity	1968 Value
Barren	1	210	W	2	689	$980
Boyle	2	321	W	2	W	W
Butler	1	83	W	1	108	W
Calloway	1	121	W	1	W	W
Carter	4	707	$945	4	774	1,166
Casey	1	W	W	1	98	180
Christian	3	1,118	1,329	4	1,955	W
Garrard	1	W	W	1	76	109
Grayson	2	176	W	2	W	W
Greenup	1	W	W	1	100	183
Hardin	5	779	1,170	5	1,076	1,601
Harrison	1	189	W	1	W	W
Hart	1	W	W	1	107	182
Jackson	2	W	W	2	175	175
Jefferson	4	1,625	2,345	4	1,787	W
Menifee	1	115	W	1	W	W
Monroe	1	100	156	1	W	307
Montgomery	1	66	W	1	W	80
Morgan	4	463	725	4	370	W
Muhlenberg	1	551	W	1	W	W
Nicholas	1	40	79	1	W	W
Oldham	3	W	W	5	1,239	1,666
Powell	2	609	W	2	W	W
Pulaski	3	283	381	3	W	W
Trigg	1	W	W	1	156	224
Warren	3	611	830	4	599	815
Wayne	1	127	W	1	W	W
Other counties [1]	64	16,569	27,522	61	20,677	35,145
Total [2]	116	24,812	35,481	118	29,979	42,762

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."

[1] Includes Adair, Allen, Anderson, Bourbon, Breckinridge, Bullitt, Caldwell, Clinton, Crittenden, Cumberland, Edmondson, Estill, Fayette, Fleming, Franklin, Green, Harlan, Henry, Jessamine, Laurel, Lee, Letcher, Livingston, Logan, Madison, Marion, Meade, Mercer, Metcalfe, Nelson, Ohio, Pendleton, Pike, Rockcastle, Rowan, Scott, Simpson, Taylor, Todd, and Wolfe Counties and counties indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 11.—Crushed limestone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967			1968		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roads	19,690	$28,051	$1.42	23,341	$33,550	$1.44
Agstone	2,110	3,365	1.59	2,190	3,486	1.57
Other uses [1]	3,012	4,066	1.35	4,449	5,776	1.30
Total [2]	24,812	35,481	1.43	29,979	42,762	1.43

[1] Includes riprap, railroad ballast, filter stone (1968), stone sand, cement, flux stone, coal mine dusting, fertilizer filler (1967), dam construction (1968), and drain fields (1968).

[2] Data may not add to totals shown because of independent rounding.

Sandstone was mined in Livingston County for use in manufacturing ferrosilicon.

Vermiculite.—Vermiculite from other States was exfoliated in a plant in Campbell County. The vermiculite was used for loose fill insulation, agricultural use, and in concrete.

METALS

The value of metallic ores was less than 1 percent of the total value of mineral production in Kentucky.

Ferroalloys.—The value of shipments of ferroalloys decreased 2 percent below that of 1967.

Lead.—Lead concentrate was recovered as a byproduct of fluorspar milling. Shipments decreased as the result of a decrease in fluorspar production.

Pig Iron and Steel.—Armco Steel Corp., produced basic and foundry pig iron at Ashland; shipments decreased 11 percent. Steel was produced by the following companies: Armco Steel Corp., at Ashland; Interlake Steel Corp., at Newport; Green River Steel Co., at Owensboro; and Kentucky Electric Steel Co., near Princess.

Zinc.—One zinc mine produced zinc concentrates. A small quantity of zinc concentrates was recovered from fluorspar milling.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt, native: Gripstop Corp	Box 66 Brownsville, Ky. 42210	Quarry	Edmonson.
Cement, masonry and portland:			
Kosmos Portland Cement Co.	802 Bank of Louisville Bldg. 510 W. Broadway Louisville, Ky. 40202	Plant	Jefferson.
Clays:			
Ball:			
Bell City Pottery	Route 1 Farmington, Ky. 42040	Open pit mine and plant.	Graves.
Kentucky-Tennessee Clay Co.	Box 77 Mayfield, Ky. 42066	do	Do.
Old Hickory Clay Co.	Box 271 Paducah, Ky. 42001	2 open-pit mines and plant.	Do.
Fire:			
American Olean Tile Co.	Lewisport, Ky. 42351	Open-pit mine and plant.	Hancock.
Ford Burchett Clay Co.	Olive Hill, Ky. 41164		Carter.
General Refractories Co.	1520 Locust St. Philadelphia, Pa. 19102	9 open-pit mines and 2 plants.	Carter and Rowan.
Harbison-Walker Refractories Co.	1800 Farmer's Bank Bldg. Pittsburgh, Pa. 15222	2 open-pit mines	Greenup and Morgan.
M. A. McCoy & Son	Oak Hill, Ohio 45656	4 open-pit mines	Greenup.
Miscellaneous:			
General Shale Products Co.	Johnson City, Tenn. 37601	Open-pit mine and plant.	Jefferson.
Harsco Corp	4th & Washington St. Cannelton, Ind. 47520	2 open-pit mines	Hancock.
Kosmos Portland Cement Co.	802 Bank of Louisville Bldg 510 W. Broadway Louisville, Ky. 40202	Open-pit mine	Jefferson.
Kenlite Division, Ohio River Sand Co., Inc.	129 River Road Louisville, Ky. 40202	Open-pit mine and plant.	Bullitt.
Owensboro Brick & Tile Co.	Ewing Road Owensboro, Ky. 42302	do	Hancock.
Coal:			
Beth-Elkhorn Corp	701 E. 3d St. Bethlehem, Pa. 18016	4 underground mines	Letcher and Pike.
Gibraltar Coal Co	150 S. Meridian St. Indianapolis, Ind. 46225	Strip mine	Muhlenberg.
Island Creek Coal Co	Wheelwright, Ky. 41669	7 underground mines	Floyd.
	444 S. Main St. Madisonville, Ky. 42431	do	Hopkins, Muhlenberg, and Union.
	Holden, Va. 25625	1 underground mine	Pike.
Peabody Coal Co	301 N. Memorial Drive St. Louis, Mo. 63102	2 underground and 6 strip mines.	Muhlenberg and Ohio.
The Pittsburgh and Midway Coal Mining Co.	15 W. 10th St. Kansas City, Mo. 64105	4 underground and 2 strip mines.	Hopkins, Muhlenberg, and Union.
United States Steel Corp	Lynch, Ky. 40855	2 underground mines	Harlan.
Coke:			
Chemical Coke Co	Dawson Springs, Ky. 42408	Plant	Hopkins.
Hooker Chemical Co	Box 33 South Shore, Ky. 41175	do	Greenup.
Semet-Solvay Div. of Allied Chemical Corp.	40 Rector St. New York, N.Y. 10006	do	Boyd.
Ferroalloys: Airco Alloys and Carbide.	Box 217 Calvert City, Ky. 42029	do	Marshall.
Fluorspar:			
Calvert City Chemical Co.	Box 305 Calvert City, Ky. 42029	2 underground mines and mill.	Livingston and Crittenden (mill).
Central Midwest Mining Co.	Rosiclare, Ill. 62982	Open-pit mine	Crittenden.
Critten Industries, Inc	Marion, Ky. 42064	do	Do.
Minerva Oil Co	Eldorado, Ill. 62930	Open-pit mine	Crittenden.
Nancy Hanks Mine, Inc	Marion, Ky. 42064	3 underground mines	Crittenden and Livingston.
Kentucky Fluorspar Co.	Marion, Ky. 42064	Mill	Crittenden.
Graphite, artificial: Carborundum Co.	Hickman, Ky. 42050	Plant	Fulton.
Iron, pig: Armco Steel Corp	Middletown, Ohio 45042	do	Boyd.
Lead: Calvert City Chemical Co.	Box 305 Calvert City, Ky. 42029	*See* Fluorspar	Livingston.
Lime, regenerated: Airco Alloys & Carbide.	3801 Highland Ave. Niagara Falls, N.Y. 14305	2 plants	Jefferson and Marshall.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Natural gas:			
Plants:			
Columbia Hydrocarbon Corp.	South Shore, Ky. 41175	Refinery	Greenup.
Kentucky Hydrocarbon Corp.	Box 128 Langley, Ky. 41645	do	Floyd.
Kentucky-West Virginia Gas Co.	Allen, Ky. 41601	do	Do.
Tennessee Gas Pipeline Co.	Box 7 Greensburg, Ky. 42743	do	Green.
Producers:			
Inland Gas Co	340—17th St. Ashland, Ky. 41101	Natural gas wells	Various.
Kentucky-West Virginia Gas Co.	Second National Bank Bldg. Ashland, Ky. 41101	do	Do.
Petroleum Exploration Co.	Leeco Road Leeco, Ky. 41343	do	Do.
Texas Gas Transmission Co.	Owensboro, Ky	do	Do.
United Fuel Gas Co	Box 1273 Charleston, W. Va. 25325	do	Do.
Perlite, expanded:			
Grefco, Inc	Box 35 Florence, Ky. 41042	Plant	Boone.
W. R. Grace & Co	62 Whittemore Ave. Cambridge, Mass. 02140	do	Campbell.
Petroleum:			
Producers:			
Ashland Oil Refining Co.	1409 Winchester Ave. Catlettsburg, Ky. 41129	Crude oil wells	Various.
Har-Ken Oil Co	Box 616 Owensboro, Ky. 42301	do	Do.
Humble Oil and Refining Co.	2010 W. Ohio St. Evansville, Ind. 47712	do	Do.
Sinclair Oil and Gas Co.	300 Fidelity National Bank Bldg. Oklahoma City, Okla. 73102	Crude oil wells	Various.
Sun Oil Co	Box 5026 Lawnsdale Evansville, Ind. 47715	do	Do.
Refineries:			
Ashland Oil and Refining Co.	1409 Winchester Ave. Catlettsburg, Ky. 41129	Refinery	Boyd.
Kentucky Oil and Refining Co.	Box 325 Betsy Layne, Ky. 41605	do	Floyd.
Louisville Refining Co.	1800 S. Western Parkway Louisville, Ky. 40212	do	Jefferson.
The Somerset Refinery, Inc.	520 Monticello St. Somerset, Ky. 42501	do	Pulaski.
Sand and gravel:			
Evansville Material, Inc	624 NW. Riverside Drive Evansville, Ind. 47708	Dredge	Henderson.
Nugent Sand Co	Box 6072 Louisville, Ky. 40206	do	Jefferson.
Ohio River Sand Co., Inc	129 River Road Louisville, Ky. 40206	do	Do.
E. T. Slider, Inc	Box 785 Jeffersonville, Ind. 47130	do	Do.
Standard Materials Corp	11 N. Penn St. Indianapolis, Ind. 46204	3 open-pit mines and plants.	Boone, Gallatin, Trimble.
Stone:			
Limestone, crushed:			
Geoghegan & Mathis, Inc.	Box 532 Bardstown, Ky. 40004	3 quarries	Henry, Nelson, Pendleton.
Kentucky Stone Co	400 Sherburn Lane Louisville, Ky. 40207	5 underground mines and 7 quarries.	Various.
Reed Crushed Stone Co., Inc.	Box 35 Gilbertsville, Ky. 42044	1 quarry	Livingston.
Three Rivers Rock Co.	Box 218 Smithland, Ky. 42081	do	Do.
Vulcan Materials Co	Box 7 Knoxville, Tenn. 37901	3 quarries and 1 underground mine.	Fayette, Jefferson, Oldham.
Sandstone, crushed: Industrial Minerals Co., Inc.	Salem, Ky. 42078	Quarry	Livingston.
Vermiculite, exfoliated: W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Plant	Campbell.
Zinc:			
Calvert City Chemical Co.	Box 305 Calvert City, Ky. 42029	*See* Fluorspar	Livingston.
Eagle-Picher Industries, Inc.	Box 910 Miami, Okla. 74354	Underground mine and mill.	Do.

The Mineral Industry of Louisiana

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Louisiana Geological Survey for collecting information on all minerals except fuels.

By Owen W. Jones [1] and Leo W. Hough [2]

Louisiana mineral output in 1968 was valued at $4.3 billion, a 9.1-percent increase over that of 1967. For the 11th consecutive year, Louisiana ranked second among the States in value of domestic mineral production. New production records were established for crude petroleum, natural gas, natural gas liquids, salt, and sand and gravel.

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[2] State Geologist, Louisiana Geological Survey, Baton Rouge, La.

Table 1.—Mineral production in Louisiana [1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Clay____thousand short tons__	995	$1,260	863	$1,163
Lime____do____	758	9,891	781	10,159
Natural gas____million cubic feet__	5,716,857	1,057,619	6,416,015	1,212,627
Natural gas liquids:				
Natural gasoline and cycle products thousand 42-gallon barrels__	41,777	130,212	49,928	156,903
LP gases____do____	43,921	92,234	57,165	91,464
Petroleum (crude)____do____	774,527	2,419,823	817,426	2,570,641
Salt____thousand short tons__	9,585	48,483	10,908	53,854
Sand and gravel____do____	20,312	27,442	20,411	26,504
Stone (shell)____do____	7,599	11,174	9,387	11,785
Sulfur (Frasch process)____thousand long tons__	4,233	139,739	4,074	162,664
Value of items that cannot be disclosed: Cement, gypsum, and miscellaneous stone____	XX	23,873	XX	23,246
Total____	XX	3,961,750	XX	4,321,010
Total 1957-59 constant dollars____	XX	3,815,269	XX	p 4,140,652

p Preliminary. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Louisiana, by parishes

(Thousands)

Parish	1967	1968	Minerals produced in 1968 in order of value
Acadia____	$138,834	$114,116	Natural gas, natural gas liquids, petroleum.
Allen____	7,903	6,361	Petroleum, natural gas, natural gas liquids.
Ascension____	33,288	10,117	Petroleum, salt, natural gas.
Assumption____	32,752	27,708	Natural gas, petroleum.
Avoyelles____	6,627	5,449	Petroleum, natural gas liquids, natural gas.
Beauregard____	14,494	9,315	Petroleum, natural gas liquids, natural gas, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Louisiana, by parishes—Continued

(Thousands)

Pairsh	1967	1968	Minerals produced in 1968 in order of value
Bienville	$12,332	$7,293	Natural gas, petroleum, clays.
Bossier	20,137	24,005	Natural gas, petroleum, natural gas liquids.
Caddo	28,525	26,324	Petroleum, natural gas, natural gas liquids, clays.
Calcasieu	72,037	62,882	Petroleum, natural gas, natural gas liquids, lime, salt, cement, sulfur, clays.
Caldwell	2,502	1,914	Natural gas.
Cameron	176,593	218,472	Natural gas, petroleum, natural gas liquids, salt, stone.
Catahoula	17,501	9,513	Petroleum, sand and gravel, natural gas.
Claiborne	34,784	27,054	Petroleum, natural gas, natural gas liquids.
Concordia	37,534	30,011	Petroleum, natural gas.
De Soto	12,878	6,458	Natural gas, petroleum.
East Baton Rouge	18,917	16,689	Cement, lime, petroleum, sand and gravel, natural gas, clays.
East Carroll	---------	28	Natural gas.
East Feliciana	W	W	Sand and gravel.
Evangeline	13,608	11,022	Petroleum, natural gas, natural gas liquids, sand and gravel.
Franklin	4,119	2,188	Petroleum, natural gas.
Grant	462	2,272	Petroleum, sand and gravel, natural gas.
Iberia	144,428	193,098	Petroleum, natural gas, salt, natural gas liquids, clays.
Iberville	64,781	53,620	Petroleum, salt, natural gas, natural gas liquids.
Jackson	4,251	2,650	Natural gas, petroleum.
Jefferson	144,309	220,804	Petroleum, sulfur, natural gas, salt, natural gas liquids, stone.
Jefferson Davis	80,786	57,825	Natural gas, petroleum, natural gas liquids, sand and gravel.
Lafayette	19,992	15,872	Natural gas, petroleum, natural gas liquids, clays.
Lafourche	315,272	445,289	Petroleum, natural gas, sulfur, natural gas liquids.
La Salle	29,925	19,733	Petroleum, natural gas, sand and gravel.
Lincoln	35,732	19,835	Natural gas liquids, natural gas, petroleum, clays.
Livingston	67	18	Petroleum, natural gas.
Madison	1,955	814	Natural gas.
Morehouse	1,891	11,760	Natural gas, natural gas liquids, petroleum.
Natchitoches	30,425	33,227	Petroleum, natural gas, natural gas liquids, clays.
Orleans	15,262	15,372	Cement, lime, natural gas.
Ouachita	11,360	24,791	Petroleum, natural gas, natural gas liquids, sand and gravel.
Plaquemines	912,908	1,093,662	Petroleum, natural gas, sulfur, natural gas liquids, salt.
Pointe Coupee	22,668	25,087	Petroleum, natural gas, natural gas liquids, clays.
Rapides	10,499	7,548	Petroleum, sand and gravel, natural gas, natural gas liquids, clays.
Red River	1,581	595	Sand and gravel, petroleum, natural gas.
Richland	22,346	16,911	Petroleum, natural gas liquids, natural gas.
Sabine	14,226	3,743	Petroleum, natural gas.
St. Bernard	19,537	32,225	Natural gas liquids, petroleum, natural gas, clays.
St. Charles	88,875	74,516	Petroleum, natural gas liquids, natural gas.
St. Helena	W	W	Sand and gravel.
St. James	10,064	10,382	Petroleum, natural gas, natural gas liquids.
St. John the Baptist	6,482	4,703	Petroleum, natural gas, stone.
St. Landry	56,187	49,302	Natural gas, petroleum, natural gas liquids.
St. Martin	101,274	80,464	Petroleum, natural gas, natural gas liquids, salt.
St. Mary	328,346	364,074	Petroleum, natural gas, natural gas liquids, salt, stone, lime.
St. Tammany	3,165	7,837	Stone, sand and gravel, natural gas, clays, petroleum
Tangipahoa	430	170	Petroleum, sand and gravel, clays.
Tensas	18,491	7,359	Petroleum, natural gas liquids, natural gas.
Terrebonne	535,504	529,991	Petroleum, natural gas, sulfur, natural gas liquids, salt.
Union	7,991	2,114	Natural gas, petroleum.
Vermilion	153,895	220,785	Natural gas, petroleum, natural gas liquids, sand and gravel.
Vernon	17	17	Sand and gravel.
Washington	621	928	Do.
Webster	36,959	31,635	Natural gas, natural gas liquids, petroleum, sand and gravel.
West Baton Rouge	845	3,497	Petroleum, natural gas, clays.
West Carroll	139	36	Natural gas.
West Feliciana	W	W	Sand and gravel.
Winn	2,439	2,823	Petroleum, gypsum, stone, sand and gravel.
Undistributed	[r] 19,998	16,707	
Total	3,961,750	4,321,010	

[r] Revised.

W Withheld to avoid disclosing individual company confiential data; included with "Undistributed."

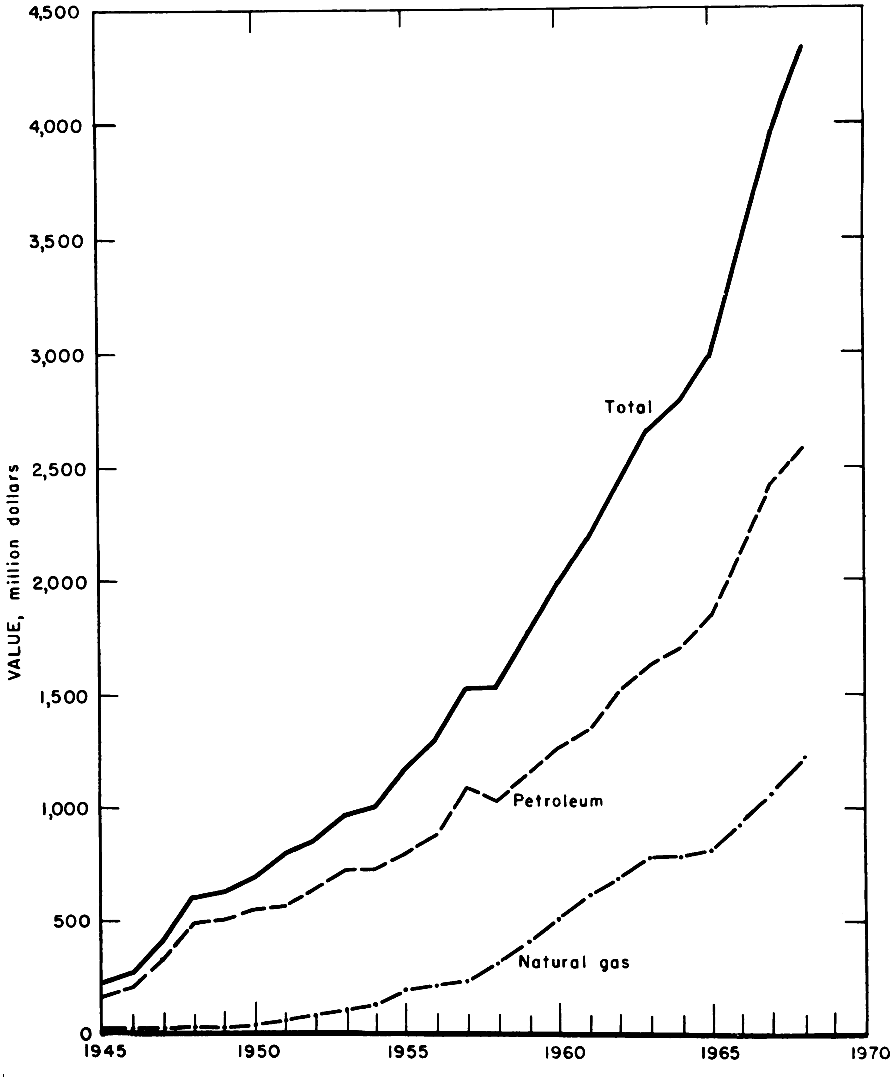

Figure 1.—Value of petroleum, natural gas, and total value of mineral production in Louisiana.

Mineral fuels—crude petroleum, natural gas, and natural gas liquids—provided 93.3 percent of the total value of mineral output. The Louisiana Geological Survey listed 33 new field discoveries, 14 oilfields and 19 gasfields. According to the American Petroleum Institute (API), net crude reserve increased 152.2 million barrels and established a new high. New field discoveries accounted for only 18.5 million barrels. In reserves added, Louisiana ranked first in the Nation in crude petroleum, natural gas, and natural gas liquids.

Trends and Developments.—Industrial development continued the long-established high-volume trend. Under Louisiana's 10-year ad valorem tax exemption plan the Board of Commerce and Industry approved applications for $624 million in new and

Table 3.—Indicators of Louisiana business activity

	1967	1968 p	Change (percent)
Employment and labor force, annual average:			
Total labor force (nonagricultural) thousands	1,030.9	1,056.3	+2.5
Unemployment do	17.3	17.0	—1.7
Employment:			
Contract construction do	89.1	92.5	+3.8
Mining do	51.2	52.3	+2.1
All manufacturing do	173.4	178.3	+2.8
All industries [1] do	1,013.6	1,039.3	+2.5
Factory payrolls millions	$1,045.2	$1,131.8	+8.3
Personal income:			
Total do	$8,995	$9,745	+8.3
Per capita	$2,456	$2,615	+6.5
Construction activity:			
Building permits, total private nonresidential millions	$136.0	$190.8	+40.3
Construction contracts awarded:			
Residential [2] thousands	$449,811	$486,065	+8.1
Nonresidential [3] do	$415,908	$368,674	—11.4
Nonbuilding do	$317,337	$242,792	—23.5
Total do	$1,183,056	$1,097,531	—7.2
Cement shipments to and within Louisiana thousand 376-pound barrels	11,773	12,545	+6.6
Farm marketing receipts millions	$594.1	$632.3	+6.4
Mineral production do	$3,961.8	$4,321.0	+9.1

p Preliminary.

[1] Transportation and public utilities; wholesale and retail trade; finance, insurance, and real estate; services; and government included.

[2] Includes apartments, hotels, dormitories, 1- and 2-family dwellings, and other residential buildings.

[3] Includes commercial, manufacturing, educational, and other nonresidential buildings.

Sources: Employment and Earnings and monthly report on the Labor Force, Bureau of Labor Statistics; Survey of Current Business; Construction Review; Louisiana Business Review, v. 33, No. 2, February 1969, p. 14; Bureau of Mines; and Farm Income Situation.

expanded industrial construction, an amount second only to the 1967 record of $718 million. Both figures included Board approved industrial bond issues ($193 million in 1968). As in the past, the interrelated petroleum, petrochemical, and chemical industries led all categories with expenditures of $350 million, approximately 56 percent of the State total. Some major facilities approved were Triad Chemical Co., Ascension Parish, $30 million (anhydrous ammonia and urea); Central Farmers Fertilizer Co., Ascension Parish, $17 million (ammonia); The Dow Chemical Co., Iberville Parish, $10 million (light hydrocarbons), $5 million (polyvinyl chloride); Vulcan Materials Co., Ascension Parish, $12 million (chlorinated organic solvents); Allied Chemical Corp., East Baton Rouge Parish, $9 million (high-density polyethylene).

Other major investment categories of interest to the mineral industry included paper and paper products, $129 million; electric power, $66 million; metals, metal products, and machinery, $37 million; and stone, clay, and glass products, $1 million.

The electric utility companies continued major construction activities. Louisiana Power and Light Co.'s 560,000-kilowatt Little Gypsy Unit No. 3 was scheduled for 1969 operation, and they were constructing a 750,000-kilowatt unit (Unit No. 4) at Ninemile Point steam-electric station at Westwego. This unit is scheduled for operation in 1971.

Gulf States Utilities construction included work on three 580,000-kilowatt generators, two 265,000-kilowatt generators, and extension of a 500,000-volt transmission system.

The Federal Power Commission (FPC) reported that electric power generated in 1968 by Louisiana plants was 26,136 million kilowatt-hours. This was 12.9 percent higher than the 1967 total and compared with a national increase of 10.4 percent. Louisiana contributed about 2.0 percent of the national electric power output.

The State's system of rivers, canals, and ports greatly facilitated transportation of minerals and mineral products. New Orleans continued as the Nation's second largest port, and Baton Rouge ranked seventh. Lake Charles, the State's third major port, handled heavy tonnages of oils and petrochemicals.

The U.S. Army Corps of Engineers was

constructing a 9-foot navigation channel in the Ouachita River. It will extend upstream to Camden, Ark., and necessitated building four locks and dams. The first lock and dam was completed, and the second was one-half completed.

The Louisiana and Texas joint project converting the Sabine River into a giant reservoir and power source was complete except for final testing and minor finishing work. The reservoir provides a dependable source of more than 1 billion gallons of water per day for industrial and commercial users. Electric power-generating capacity will be 80,750 kilowatts. Major water users will include petrochemical plants in the Lake Charles area. Recreational facilities also were being constructed.

Capacity of Louisiana natural gas processing plants was increased 10.3 percent, whereas product output increased 25.0 percent. Storage space in salt dome caverns was increased 2.5 million barrels (13 percent).

Of $704 million total tax collections in Louisiana for the fiscal year ending 1968, $237 million was from severance taxes levied on minerals ($233 million from mineral fuels). Other mineral-related taxes accounted for an additional $98 million.

Legislation.—The dispute between Louisiana and the Federal Government over the location of Louisiana's offshore boundary has been active for some 30 years. In May 1960, the U.S. Supreme Court decreed the Louisiana boundary to be 3 geographical miles seaward from the coastline—not 3 leagues. In late 1965 the Court determined portions of the boundary. At present, seven oil and gas fields—two of them giants—are in the disputed zone. At the end of 1968 approximately $1.25 billion was in escrow to be divided when ownership is established. The escrow account contains bonuses, royalties, and rental payments.

Employment and Injuries.—Employment in the petroleum production, refining, and related industries averaged 102,300 persons, an increase of 1,950. Oil and gas operations provided 92.3 percent of employment, and 92.8 percent of wages derived from the mineral industry. In 1968 a salt industry strike idled about 350 workers for 1 month. A dockworkers' strike began about the middle of December, and about 4,100 workers remained on strike at yearend.

A disastrous fire at the Belle Isle salt mine, St. Mary Parish, occurred in March. The Bureau of Mines, Safety Division, participated in rescue attempts, but all 21 men underground at the time of the fire perished.

An explosion and fire on a workover rig 3 miles offshore in the Gulf of Mexico took the lives of nine men in August. The rig was doing remedial work in the West Delta 27 gasfield.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Nonfatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1967:								
Metal	820	365	299	2,394	-------	9	3.76	198
Nonmetal	1,925	302	581	4,719	4	90	19.92	5,771
Sand and gravel	1,228	237	291	2,600	-------	46	17.70	388
Stone	692	336	232	1,946	-------	38	19.53	5,118
Total [1]	4,665	301	1,404	11,659	4	183	16.04	3,317
1968: [p]								
Metal	810	365	296	2,364	-------	11	4.65	145
Nonmetal	2,070	296	613	5,481	24	116	25.54	27,781
Sand and gravel	640	234	150	1,364	1	18	13.93	4,782
Stone	680	337	230	1,954	-------	47	24.06	638
Total [1]	4,200	307	1,288	11,163	25	192	19.44	14,367

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Table 5.—Total wage and salaried workers in petroleum production, refining, and related industries

Year	Crude petroleum and natural gas production	Petroleum refining [1]	Pipeline transportation (except natural gas)	Gas utilities	Petroleum bulk tank stations	Retail filling stations	Chemicals and allied products [2]	Total
1964	43,100	10,400	950	6,100	4,100	9,650	17,100	91,400
1965	46,500	10,400	850	6,050	4,300	10,000	17,100	95,200
1966	47,200	9,200	900	5,900	4,300	10,500	20,200	98,200
1967	47,100	9,800	900	5,850	4,400	10,800	21,500	100,350
1968 p	47,800	10,400	900	5,750	4,550	11,000	21,900	102,300

p Preliminary.

[1] Employment in chemical and petroleum refineries and petrochemicals manufactured in petroleum refineries.

[2] Employment in chemical and petrochemical manufacturing facilities located outside petroleum refineries.

Source: Louisiana State Department of Labor, Division of Employment Security.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

New highs for production were established for all mineral fuels. At yearend, 1,315 oilfields and gasfields in the State had 39,429 productive wells (39,206 in 1967) as follows: North Louisiana, 13,780 oil and 4,507 natural gas wells; south Louisiana, onshore, 11,653 oil and 3,487 natural gas wells, and offshore 4,833 oil and 1,169 natural gas wells.

Leasing Activity.[3]—In north Louisiana, block leasing was greatest in Grant, Jackson, Madison, Richland, and Winn Parishes. Lease bonuses ranged from $5 to $50 per acre. In south Louisiana; onshore leasing activity continued to decrease slightly.

The State held six lease sales of public lands. These sales included leases in zone 1 and areas in Main Pass, Breton Sound, and Chandeleur Sound. A total of 146,809 acres was leased for an average bonus of $122.55 per acre.

A Federal Government drainage sale was held November 19 for offshore acreage in disputed zone 2. The 16 tracts totaled 29,679 acres and leased for an average bonus of $5,049 per acre. The highest bid was $94.2 million for a 3,438-acre tract in West Delta Blocks 79 and 80. This overshadowed a bid of $21.3 million on 1,875 acres in South Timbalier Block 26.

Exploration, Development, and Reserves.—According to the Louisiana Geological Survey a total of 4,097 wells drilled statewide and offshore resulted in 1,734 oil completions, 840 gas completions, and 1,523 dry holes. Of the 3,544 developmental wells drilled, 2,541 or 71.7 percent were productive. Of the 553 exploratory wells drilled, 33 or 6.0 percent were productive (14 oil completions and 19 gas completions).

Offshore drilling totaled 1,461 wells—1,307 developmental and 154 exploratory. The developmental wells resulted in 712 oil completions, 330 gas completions, and 265 dry holes (80 percent successful). The exploratory wells discovered five oilfields and four gasfields.

Inland drilling totaled 2,636 wells—2,237 developmental wells and 399 exploratory wells. The developmental wells resulted in 1,008 oil completions, 491 gas completions, and 738 dry holes (67 percent successful). In north Louisiana developmental wells totaled 837 of which 325 were oil, 204 were gas, and 308 were dry (63 percent successful). In south Louisiana the 1,400 developmental wells resulted in 683 oil completions, 287 gas completions, and 430 dry holes (69 percent successful).

Inland exploratory wells totaled 399—203 in north Louisiana and 196 in south Louisiana. North Louisiana exploratory operations resulted in discovery of four oilfields and four gasfields (4 percent successful). South Louisiana exploratory operations resulted in discovery of five oilfields and 11 gasfields (8 percent successful).

Subsurface geology was the main exploratory guide in north Louisiana. Most deep exploration, however, was based on a

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[3] Adapted from the American Association of Petroleum Geologists Bulletin, v. 53, No. 6, June 1969.

Table 6.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1968

Location	Drilling							Geophysical crew-weeks		
	Proved field wells [1]			Exploratory wells [1]			Total	Gravity meter method	Reflection seismograph method	Total
	Oil	Gas	Dry	Oil	Gas	Dry				
North:										
Bienville	2	12	3	-----	-----	5	22	-----	6.0	6.0
Bossier	41	3	5	-----	-----	8	57	-----	9.0	9.0
Caddo	109	6	13	-----	-----	-----	128	-----	2.0	2.0
Caldwell	-----	3	5	-----	2	10	20	-----	15.0	15.0
Catahoula	1	-----	22	2	-----	32	57	-----	.5	.5
Claiborne	12	2	10	-----	-----	4	28	-----	10.0	10.0
Concordia	37	-----	52	1	-----	77	167	-----	-------	-------
De Soto	2	15	24	1	-----	3	45	-----	-------	-------
East Carroll	-----	-----	-----	-----	-----	-----	-----	-----	9.0	9.0
Franklin	2	-----	1	-----	-----	6	9	-----	5.5	5.5
Grant	3	-----	3	-----	-----	2	8	-----	2.5	2.5
Jackson	-----	2	3	-----	-----	3	8	-----	18.5	18.5
La Salle	62	3	66	-----	1	17	149	-----	7.5	7.5
Lincoln	-----	-----	1	-----	-----	1	2	-----	7.0	7.0
Madison	-----	-----	-----	-----	-----	3	3	-----	20.0	20.0
Morehouse	-----	22	-----	-----	-----	1	23	-----	18.0	18.0
Natchitoches	-----	-----	2	-----	-----	3	5	-----	5.0	5.0
Ouachita	-----	9	5	-----	-----	1	15	-----	8.0	8.0
Red River	-----	-----	3	-----	-----	-----	3	-----	-------	-------
Richland	5	75	17	-----	1	1	99	-----	12.0	12.0
Sabine	10	1	40	-----	-----	2	53	-----	11.0	11.0
Tensas	11	4	14	-----	-----	5	34	-----	2.0	2.0
Union	1	35	3	-----	-----	1	40	-----	23.0	23.0
Webster	4	9	9	-----	-----	1	23	-----	3.5	3.5
West Carroll	-----	-----	-----	-----	-----	-----	-----	-----	6.5	6.5
Winn	23	3	7	-----	-----	9	42	-----	52.0	52.0
Total:										
1968	325	204	308	4	4	195	1,040	-----	253.5	253.5
1967	393	185	405	13	16	236	1,248	-----	185.0	185.0
South:										
Acadia	3	17	31	-----	-----	3	54	-----	16.0	16.0
Allen	1	-----	8	-----	-----	4	13	-----	8.0	8.0
Ascension	5	1	2	-----	-----	2	10	-----	3.0	3.0
Assumption	-----	2	2	-----	1	11	16	-----	17.0	17.0
Avoyelles	6	-----	6	1	-----	16	29	-----	18.0	18.0
Beauregard	6	1	6	-----	-----	9	22	-----	59.0	59.0
Calcasieu	32	16	22	-----	2	10	82	-----	72.0	72.0
Cameron	47	35	40	1	1	23	147	-----	55.0	55.0
East Baton Rouge	-----	-----	2	-----	-----	-----	2	-----	4.0	4.0
East Feliciana	-----	-----	-----	-----	-----	1	1	-----	-------	-------
Evangeline	2	2	2	-----	-----	1	7	-----	13.0	13.0
Iberia	20	11	15	-----	1	2	49	-----	39.0	39.0
Iberville	15	9	11	-----	-----	9	44	-----	59.0	59.0
Jefferson	33	4	4	-----	-----	4	45	-----	20.0	20.0
Jefferson Davis	6	13	18	-----	-----	5	42	-----	21.0	21.0
Lafayette	2	5	6	-----	-----	1	14	-----	53.0	53.0
Lafourche	70	15	37	1	2	9	134	-----	67.0	67.0
Livingston	-----	-----	-----	-----	-----	1	1	-----	58.0	58.0
Orleans	-----	-----	-----	-----	-----	-----	-----	-----	7.0	7.0
Plaquemines	142	19	29	-----	-----	13	203	-----	46.0	46.0
Pointe Coupee	21	7	9	-----	-----	3	40	-----	4.0	4.0
Rapides	8	1	28	-----	-----	2	39	-----	6.0	6.0
St. Bernard	5	2	3	-----	1	4	15	-----	20.0	20.0
St. Charles	22	13	8	-----	-----	3	46	-----	9.0	9.0
St. James	2	5	5	-----	-----	-----	12	-----	-------	-------
St. John the Baptist	-----	-----	2	-----	-----	1	3	-----	15.0	15.0
St. Landry	3	9	12	-----	-----	6	30	-----	81.0	81.0
St. Martin	22	10	16	-----	-----	9	57	-----	20.0	20.0
St. Mary	44	35	21	1	2	5	108	-----	139.0	139.0
Terrebonne	147	37	54	-----	1	12	251	-----	74.0	74.0
Vermilion	12	17	30	-----	-----	11	70	-----	90.0	90.0
Vernon	-----	-----	-----	-----	-----	-----	-----	-----	2.0	2.0
Washington	-----	-----	-----	-----	-----	-----	-----	-----	2.0	2.0
West Baton Rouge	7	1	1	1	-----	-----	10	-----	4.0	4.0
West Feliciana	-----	-----	-----	-----	-----	-----	-----	-----	1.0	1.0
Total:										
1968	683	287	430	5	11	180	1,596	-----	1,102.0	1,102.0
1967	413	114	214	28	56	344	1,169	-----	1,422.0	1,422.0

See footnote at end of table.

Table 6.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1968—Continued

Location	Drilling							Geophysical crew-weeks		
	Proved field wells[1]			Exploratory wells[1]			Total	Gravity meter method	Reflection seismograph method	Total
	Oil	Gas	Dry	Oil	Gas	Dry				
Offshore:										
Bay Marchand	27	2	13	-----	-----	-----	42	-----	-------	-------
Breton Sound	14	3	6	-----	-----	8	31	-----	12.0	12.0
Chandeleur Sound	-----	-----	1	-----	-----	2	3	-----	50.0	50.0
East Cameron	-----	10	10	-----	1	1	22	-----	55.0	55.0
Eugene Island	38	11	42	-----	-----	5	96	-----	128.0	128.0
Grand Isle	122	18	23	-----	-----	8	171	-----	23.0	23.0
Main Pass	69	52	28	1	1	40	191	-----	16.0	16.0
Marsh Island	3	7	-----	-----	-----	-----	10	-----	-------	-------
Ship Shoal	144	64	34	2	-----	15	259	-----	31.0	31.0
South Marsh Island	11	17	26	-----	-----	3	57	-----	39.0	39.0
South Pass	129	11	17	2	-----	27	186	-----	26.0	26.0
South Pelto	4	2	5	-----	-----	-----	11	-----	3.0	3.0
South Timbalier	55	28	14	-----	1	6	104	-----	17.0	17.0
Vermilion	10	15	7	-----	-----	4	36	-----	76.0	76.0
West Cameron	10	67	14	-----	1	4	96	-----	81.0	81.0
West Delta	76	23	25	-----	-----	22	146	4.0	35.0	39.0
Total:										
1968	712	330	265	5	4	145	1,461	4.0	592.0	596.0
1967	397	133	167	52	42	274	1,065	30.0	621.0	651.0
Grand total:										
1968	1,720	821	1,003	14	19	520	4,097	4.0	1,947.5	1,951.5
1967	1,203	432	786	93	114	854	3,482	30.0	2,228.0	2,258.0

[1] Each completion is counted as 1 well.

Sources: Louisiana Geological Survey and International Oil Scouts Association.

Table 7.—Crude petroleum, natural gas, and natural gas liquids production and net changes in proved reserves

Year	Crude petroleum (million barrels)		Natural gas (billion cubic feet)		Natural gas liquids (million barrels)	
	Production	Net changes in reserves	Production	Net changes in reserves	Production	Net changes in reserves
1964	550	74	4,153	3,711	62	101
1965	595	83	4,467	3,735	65	227
1966	674	163	5,081	873	72	114
1967	775	48	5,717	2,606	86	325
1968	817	152	6,416	1,726	107	60
	Total proved reserves, Dec. 31, 1968					
1968	5,608		88,016		2,668	

Source: Reserves based on American Gas Association, and American Petroleum Institute. Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas. Tulsa Daily World, 64th yr., No. 206, Apr. 7, 1969, p. 10.

combination of geophysical and geological information. Total seismic crew-weeks reported for north Louisiana was 253.5. Winn Parish, most active with 52 crew-weeks, was followed by Union with 23 and Madison with 20. The most active area of development in Upper Cretaceous sediments was in the Caddo-Pine Island field, Caddo Parish. Drilling for Upper Cretaceous production in the Pendleton-Many, Fort Jessup, and Converse fields in Sabine Parish declined. Three Sligo (Lower Cretaceous) wildcats were drilled in LaSalle Parish during 1968; all resulted in dry holes. Drilling in LaSalle Parish is normally confined to the Wilcox Formation (Tertiary), and the Sligo tests contributed additional stratigraphic information.

In south Louisiana, including offshore, the average depth of exploratory wells was 11,402 feet; of development wells, 9,685 feet, according to the American Association of Petroleum Geologists (AAPG). Onshore exploratory wells were fewer than in 1967 and only 8.9 percent of the wells was productive of oil or gas. Offshore exploratory drilling increased following the 1967 lease sale, but the percentage of successful exploratory wells was only 6.2 percent. Some notable discoveries were West Manchester, Calcasieu Parish; Block 14, East Cameron area; Block 61, South Pass area; Block 200 and Block 305, Main Pass area.

Geophysical activity in onshore south Louisiana again decreased. Reported crew-weeks onshore were 1,102, and offshore, 596, for a total of 1,698. Offshore activity also decreased from 651 to 596 crew-weeks.

According to the AAPG, 29.7 million feet of hole, 15.1 percent more than in 1967, was drilled in the State. An average of 233 drilling rigs operated statewide, 2 less than in 1967; 91 rigs operated offshore in both 1967 and 1968.

According to API, proved reserves of crude oil, natural gas, and natural gas liquids reached new highs. At yearend the crude oil reserve (5,608 million barrels) comprised 18.3 percent of the total U.S. reserve; the natural gas reserve (88,016 billion cubic feet) was 30.6 percent; the natural gas liquids reserve (2,668 million barrels) was 31.0 percent of the total. Of gross additions to Louisiana's crude petroleum reserve 2.2 percent was attributed to new fields; 15.1 percent to new reservoirs in old fields, and the remainder to extensions and revisions of previously discovered reservoirs.

Carbon Black.—Production was 1,031 million pounds, valued at $70 million, a 15-percent increase in value. Louisiana accounted for 34 percent of the national value. About 29 billion cubic feet of natural gas yielded an average of 11.2 pounds of carbon black per 1,000 cubic foot of gas; average yield from 144 million gallons of liquid hydrocarbons was 4.9 pounds per gallon.

Table 8.—Carbon black production

Year	Million pounds
1964	726
1965	821
1966	899
1967	923
1968	1,031

Virtually all the carbon black produced in Louisiana was from furnace plants. St. Mary and Ouachita Parishes had production from three plants; Avoyelles, Calcasieu, and Evangeline Parishes each had one plant. Daily capacity for the State industry was 3.2 million pounds—up 7.4 percent from that of last year. Nationwide, 94.4 percent of production was directed to the rubber industry; 2.6 percent was used in carbon ink; 1.0 percent in plastics; and the remainder was used in paint, paper, chemicals, foods, and miscellaneous.

Sid Richardson Carbon Co. started constructing a 70-million-pound-per-year carbon black plant in West Baton Rouge Parish. The furnace-type installation will use refinery residues from the Humble Oil & Refining Co. plant at Baton Rouge. Startup is expected in late 1969.

Natural Gas.—Marketed production of natural gas increased 12.2 percent. Louisi-

Table 9.—Natural gas data

(Million cubic feet)

Year	Withdrawals [1]			Marketed production [2]	Value at wells (thousands)	Disposition	
	From gas wells	From oil wells	Total			Repressuring	Vented and wasted [3]
1964	3,682,200	808,400	4,490,600	4,152,731	$793,328	221,280	116,589
1965	3,912,300	852,000	4,764,300	4,466,786	812,955	174,951	122,563
1966	4,168,820	1,196,457	5,365,277	5,081,435	929,902	182,734	101,108
1967	5,070,825	1,016,600	6,087,425	5,716,857	1,057,619	208,719	161,849
1968	5,623,961	1,153,555	6,777,516	6,416,015	1,212,627	195,062	166,439

[1] Marketed production plus quantities used in repressuring, vented, and wasted.

[2] Comprises gas sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in pipelines.

[3] Partly estimated. Includes direct waste on producing properties and residue blown to the air.

ana retained its position of second among the States as a producer of natural gas, supplying 33.2 percent of the total marketed domestic natural gas.

Offshore Louisiana gas pipeline projects totaling more than 1,000 miles in length and more than $250 million estimated costs were submitted to or approved by the Federal Power Commission (FPC) in fiscal year 1968. Applications included 185 miles of 24-inch, 214 miles of 26-inch, and 189 miles of 30-inch pipe.

In late 1967, Trunkline Gas Co., a subsidiary of Panhandle Eastern Pipeline Co., signed major purchase contracts with Shell Oil Co. and Standard Oil Company of California for natural gas from fields in the Ship Shoal, South Timbalier, and South Pelto offshore areas. Standard Oil Company of California dedicated all future gas production from about 47,000 acres of offshore leases, and Shell Oil Co. dedicated production from about 45,000 acres. Trunkline Gas Co. received FPC approval for a 200-mile pipeline to bring the gas ashore. The company asserted this project will be the largest underwater pipeline yet attempted. The line will extend 60 miles into the Gulf, and will be laid in water as deep as 200 feet. Almost half the line will be 30-inch-diameter pipe.

Transcontinental Gas Pipe Line Corp., largest buyer of offshore gas, applied to the FPC for approval to build three offshore pipelines: (1) a 26-inch line to shore from Ship Shoal Block 208; (2) a 15-mile, 8-inch-diameter line from Ship Shoal Blocks 107 and 108 to the existing Transco system in Ship Shoal Block 92; and (3) a 30-mile, 24-inch-diameter line from South Marsh Island Block 66 to Eugene Island Block 128 where it will connect to an existing 24-inch line to shore.

A major offshore reserve of natural gas was committed to Michigan Wisconsin Pipeline Co., a subsidiary of American Natural Gas Co., New York. This reserve in Ship Shoal Blocks 204, 205, 207, and 216 was committed by Placid Oil Co. for 20 years.

Pan American Petroleum Corp. at midyear started deliveries on a new gas contract for 192 million cubic feet per day (MMcfd) to Florida Power and Light Co. The old 1966 contract was 80 MMcfd.

In September the FPC set ceiling rates for natural gas produced in southern Louisiana (all Louisiana south of the 31st parallel), an area which provides nearly one-third of all natural gas sold in interstate commerce. This decision set a three-tier price structure. A ceiling price of 18.5 cents per thousand cubic feet (Mcf) was set for gas produced under contracts dated prior to January 1, 1961. Ceiling prices set for gas produced under contracts dated January 1, 1961, through Sept. 30,1968, were 20 cents per Mcf if produced from gas wells and 18.5 cents if produced as a byproduct of oil wells. Gas produced under contracts dated after September 30, 1968, would have a ceiling of 20 cents per Mcf. These prices applied to gas subject to the Louisiana production tax; gas not subject to this tax would have a ceiling rate 1.5 cents lower. The ceilings would allow an overall 12-percent return on investment according to the FPC. Producers had sought a 16- to 18-percent return.

Mississippi River Transmission Corp., applied to the FPC for permission to convert the depleted West Unionville field in Lincoln Parish into a natural gas storage reservoir, and Arkansas Louisiana Gas Co. sought approval to convert the Ruston field. Two storage reservoirs, the United Gas Pipeline Co., Lake Bistineau field, Bienville Parish; and the South Louisiana Production Co., Holly field, DeSoto Parish; had a total capacity of 105.5 billion cubic feet on July 1, 1968. Some gas produced from offshore and southern Louisiana is stored during summer months for delivery during the winter season, enabling the pipeline companies to meet peak demands.

Natural Gas Liquids.—Production again ranked second in the Nation and established a new record for Louisiana. The State's daily processing capacity increased from 16.1 billion cubic feet, January 1, 1968, to 17.8 billion cubic feet, January 1, 1969 (26.0 percent of the Nation's total capacity), according to the annual survey conducted by The Oil and Gas Journal.

Natural gasoline and cycle products were recovered in 34 parishes at 110 gasoline plants, 17 recycling plants, and five fractionators (112 gasoline, 16 recycling plants, and five fractionators in 1967).

Table 10.—Natural gas liquids production

(Thousand 42-gallon barrels and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	32,214	$91,931	29,702	$45,935	61,916	$137,866
1965	34,091	102,731	30,953	46,101	65,044	148,832
1966	37,192	113,802	34,993	72,016	72,185	185,818
1967	41,777	130,212	43,921	92,234	85,698	222,446
1968	49,928	156,903	57,165	91,464	107,093	248,367

Recovery of natural gas liquids gained 25 percent and amounted to 19.5 percent of the Nation's annual output. Production was 53 percent liquefied petroleum gases, and 47 percent natural gasoline and cycle products.

Humble Oil & Refining Co. completed expansion of its Garden City processing plant in June. Plant capacity was increased from 640 to 900 MMcfd. Plant product, ethane and heavier components, is piped to the company's Baton Rouge refinery. Humble also completed a 300-MMcfd capacity plant at Lirette field, Terrebonne Parish.

Mobil Oil Corp. started expanding its Riverside fractionating plant to increase raw make capacity from 20,000 barrels per day to a total of 30,000 barrels per day. Completion was scheduled for early 1969. Plans included underground storage caverns in the Napoleonville salt dome, 17 miles south of Geismar. Two 300,000-barrel caverns—one for propane, one for unfractionated liquids—will be developed initially.

Pan American Petroleum Corp. completed expansion of its TSMA plant in Vermilion Parish. Capacity was increased 220 MMcfd.

The gas processing plant capacity at Forked Island on the Intracoastal Canal was expanded. The plant now extracts 6,800 barrels of liquids each day as compared with 2,000 barrels previously.

Shell Oil Co. built a 70-MMcfd plant at Mermentau in Acadia Parish; a 71-MMcfd plant at Bayou Goula, Iberville Parish; and added 30 MMcfd to capacity of West Lake Verret plant in St. Martin Parish.

Sun Oil Co. started building a 50-MMcfd plant at Fordoche, Pointe Coupee Parish. Tenneco Oil Co. completed a 35-MMcfd plant at Haynesville, Claiborne Parish. Texaco Inc., was increasing capacity at its Henry plant, Vermilion Parish, by 825 MMcfd. Wanda Petroleum Co. doubled liquid capacity at the Breaux Bridge fractionating plant to 2,100,000 gallons per day.

Underground storage capacity for natural gas liquids and ethylene increased 13 percent to 21.2 billion barrels at yearend. As reported by The Oil and Gas Journal, capacity was 17.5 million barrels of natural gas liquids and 3.7 million barrels of ethylene.

Petroleum.—The Louisiana petroleum industry established a production record of 817.4 million 42-gallon barrels, 5.5-percent higher than last year's record production and second highest in the Nation. Petroleum was produced in 54 of the 64 parishes. Allowable production factor at the end of 1967 was 40 percent of base depth-bracket allowable. The percentage factors by months were January, 40; February, 42; March, 44; April, May, and June, 42; July and August, 43; September, 41; October, November, and December, 40. For the intermediate area, allowables remained at 130 percent of the onshore depth-bracket allowable. During February the Conservation Commission authorized overproduction up to 20 percent; the overproduction to be compensated by later underproduction. This temporary increase was allowed to prevent a fuel-oil shortage. For the months of May, June, and July, 5 percent overproduction was permitted to satisfy spot demands (fillup for Capline pipeline and rebuilding stocks after refinery "turnarounds"). This overproduction had to be compensated by the end of August.

Table 11.—Crude petroleum production

(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value
1964	549,698	$1,709,622
1965	594,853	1,841,714
1966	674,318	2,097,129
1967	774,527	2,419,823
1968	817,426	2,570,641
1902–68	10,345,080	27,993,625

Table 12.—Crude petroleum production, indicated demand, and stocks in 1968, by months

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks (end of month)
January	67,700	66,008	28,246
February	67,464	68,504	27,206
March	70,522	67,948	29,780
April	64,277	66,830	27,227
May	70,367	70,855	26,739
June	67,524	65,887	28,376
July	69,473	71,344	26,505
August	70,551	64,150	32,906
September	66,081	63,626	35,361
October	67,342	67,666	35,037
November	66,631	62,974	38,694
December	69,494	71,732	36,456
Total:			
1968	817,426	807,524	XX
1967	774,527	774,722	XX

XX Not applicable.

Table 13.—Number of producing oil wells and average production per well per day

Year	Approximate number of producing wells Dec. 31	Average production per well per day (barrels)[1]
1964	29,452	51.0
1965	30,179	54.0
1966	31,063	59.5
1967	30,670	69.2
1968	30,266	74.0

[1] Based on number of wells producing Dec. 31.

Table 14.—Production of crude petroleum by districts and selected fields

(Thousand 42-gallon barrels)

District and field[1]	1967	1968
GULF COAST ONSHORE[2]		
Bastian Bay	4,436	5,308
Bay Ste Elaine	9,023	8,912
Bayou'Sale	9,767	9,070
Caillou Island	33,040	34,028
Cote Blanche Bay West	5,409	9,720
Delta Farms	2,481	2,286
Erath	2,537	3,191
Garden Island Bay	13,541	15,336
Golden Meadow	4,088	4,084
Grand Bay	7,523	6,926
Hackberry West	4,387	4,447
Iowa	902	766
Jennings	382	336
La Fitte	10,203	11,814
Lake Barre	16,228	12,696
Lake Washington	12,371	13,105
Leeville	4,297	4,086
Paradis	4,449	5,487
Quarantine Bay	8,768	9,017
Venice	7,220	7,128
Vinton	1,870	2,127
Weeks Island	8,247	9,638
West Bay	12,587	12,084
Other	243,771	245,932
Total onshore	427,527	437,524
OFFSHORE[2]		
Bay Marchand Block 2	30,908	29,797
Eugene Island Block 126	6,282	6,162
Grand Isle Block 16	14,212	15,592
Grand Isle Block 47	4,193	3,087
Grand Isle Block 43	10,124	13,756
Main Pass Block 35	4,880	4,438
Main Pass Block 41	13,111	18,272
Main Pass Block 69	12,832	11,672
South Marsh Island Block 73	3,044	4,970
South Pass Block 24	23,568	21,647
South Pass Block 27	22,955	21,889
South Timbalier Block 135	13,114	14,941
Timbalier Bay	33,038	35,815
West Delta Block 30	23,744	23,473
West Delta Block 73	13,249	12,910
Other	62,896	90,610
Total offshore	292,095	329,031
Total Gulf Coast	719,622	766,555
NORTHERN		
Caddo-Pine Island	5,012	4,298
Cotton Valley	2,782	3,174
Delhi	4,523	4,747
Haynesville	2,155	1,804
Homer	527	438
Lake St. John	2,169	2,318
Pendleton-Many	1,297	632
Rodessa	1,031	540
Other	35,409	32,920
Total Northern	54,905	50,871
Total Louisiana	774,527	817,426

[1] Breakdown for individual fields from The Oil and Gas Journal.
[2] Some fields include onshore and offshore.

Table 15.—Crude petroleum production and estimated reserves in Louisiana offshore area

(Thousand 42-gallon barrels)

Offshore area	Number of wells		Production			Estimated reserve Dec. 31, 1968
	1967	1968	1967	1968	Cumulative total	
Bay Marchand Block 2 [1] [2]	484	413	30,908	29,797	244,239	356,297
Belle Isle [2]	59	55	1,874	2,142	19,702	15,298
Caillou Island [1] [2]	801	692	33,040	34,028	356,884	143,116
East Cameron Block 64	42	61	1,274	1,315	5,036	7,064
Eugene Island:						
Block 18	55	49	3,100	2,931	28,316	11,684
Block 32	42	37	1,739	1,565	16,046	18,954
Block 126 [1]	122	130	6,232	6,162	58,194	66,806
Block 128	60	67	3,101	2,931	26,675	33,325
Block 188	61	63	3,170	3,589	15,977	19,023
Block 208	36	34	1,167	1,212	9,270	25,730
Block 238	20	--------	1,364	--------	2,442	8,101
Block 276	68	74	3,288	4,094	8,073	35,907
Grand Isle:						
Block 41	--------	37	--------	2,730	4,490	27,301
Block 16 [1]	243	167	14,212	15,592	96,060	78,940
Block 18	42	32	2,133	2,087	28,012	11,988
Block 43 [1]	163	242	10,124	13,756	38,601	61,399
Block 47 [1]	70	36	4,193	3,087	42,916	57,508
Lake Washington [1] [2]	373	329	12,371	13,105	152,292	149,471
Main Pass:						
Block 41 [1]	221	170	13,111	18,272	45,509	54,491
Block 69 [1]	239	211	12,832	11,672	127,466	172,534
Mound Point	--------	28	--------	1,373	3,624	14,611
Rabbit Island	39	40	2,899	2,690	8,715	27,310
Ship Shoal:						
Block 28	27	6	2,956	1,635	13,169	16,931
Block 107	54	48	4,038	3,945	24,906	35,094
Block 154	55	56	3,114	2,738	20,173	27,837
Block 176	34	38	1,861	2,136	10,217	11,783
Block 208	63	104	4,613	6,626	20,607	45,159
Block 113	38	62	1,365	2,645	5,650	8,720
South Marsh Island:						
Block 6	25	28	1,703	1,997	6,927	31,485
Block 23	39	40	2,198	1,647	9,764	44,218
Block 73	73	86	3,044	4,970	10,045	25,074
South Pass:						
Block 24 [1] [2]	668	626	23,568	21,647	301,240	448,760
Block 27 [1]	458	458	22,955	21,889	156,189	154,811
Block 62	--------	46	--------	1,626	1,654	18,002
South Pelto: Block 20	43	46	1,678	2,141	9,149	10,851
Tiger Shoal	40	50	2,209	2,442	10,090	19,558
Timbalier Bay [1] [2]	606	597	33,033	35,815	228,035	71,965
South Timbalier:						
Block 54	--------	29	--------	2,220	4,948	23,001
Block 131	60	53	2,856	3,162	18,099	31,901
Block 135 [1]	174	204	13,114	14,941	53,999	46,001
Block 176	41	88	2,019	3,349	6,296	16,668
Vermilion:						
Block 14	53	75	1,842	2,364	13,239	18,761
Block 16	--------	17	--------	1,585	3,986	17,002
Block 245	39	41	2,853	2,620	7,192	26,630
West Delta:						
Block 105	53	54	2,906	2,925	7,608	12,981
Block 30 [1]	431	279	23,744	23,473	168,863	231,137
Block 27	103	104	7,704	15,972	38,452	47,455
Block 41	67	82	5,069	5,137	15,773	49,001
Block 73 [1]	214	188	13,249	12,910	44,739	55,261
Block 117	--------	20	--------	1,333	2,566	16,705
Block 133	--------	23	--------	1,380	2,442	18,900
Total	6,698	6,515	345,823	381,400	2,554,556	2,978,510

[1] Estimated ultimate recovery of 100 million barrels or more.

[2] Combined onshore and offshore.

Source: The Oil and Gas Journal. V. 67, No. 4, Jan. 27, 1969, pp. 138–141.

Secondary production was from 684 projects in 160 fields. The initiation of 126 new projects helped increase secondary recovery production more than 18.6 million barrels. Secondary recovery projects accounted for 172 million barrels, or 21 percent of the 1968 production, according to the Louisiana Conservation Department. Forty-four projects were abandoned in 1968, raising the cumulative number of abandoned projects to 306.

At yearend, 13,079 producing wells were

classified as "stripper" wells. This number represented 43.2 percent of total oil wells producing, but production (10.2 million barrels) was only 1.3 percent of the State total.

Capline, the Western Hemisphere's biggest crude oil line, began delivering 200,000 barrels of oil per day from Louisiana to the Chicago, Ill., area in September. With five pump stations in operation, rated capacity was 417,000 barrels per day. Ultimate capacity, with a total of 16 stations, will be 1,080,000 barrels per day. The line will change crude flow patterns in both Louisiana and Texas.

Refineries.—At yearend 16 petroleum refineries were operating in Louisiana. Crude oil capacity totaled 1,190,850 barrels per calendar day according to The Oil and Gas Journal, a gain of approximately 80,000 barrels over 1967 capacity. Crude oil processed in Louisiana refineries totaled 414.4 million barrels (95.3 percent of capacity and 50.1 million barrels more than in 1967) and represented 50.7 percent of the crude oil production in the State.

Texaco Inc., started expanding its new refinery at Convent from 100,000-barrel-per-day capacity to 144,000 barrels per day. The refinery, which went on stream in mid-1967, is on the east bank of the Mississippi River southeast of Baton Rouge. The expansion is expected to be completed in 1969.

The 3-year expansion and modernization program at the Shell Oil Co. Norco refinery was completed early in the year. Crude charge capacity was increased 34 percent. The changes also have made it possible to convert 16,000 barrels per day of low-grade residual stock to distillate, and to produce 600 tons per day of high-quality petroleum coke.

Completion of a major expansion project raised the crude charge capacity of the Humble Oil & Refining Co. refinery at Baton Rouge to 449,000 barrels per day. This is the only U.S. refinery with a daily capacity exceeding 400,000 barrels. Two coke drums and attendant facilities were being added to an existing four-drum unit.

Tenneco Oil Co. completed a 2-year expansion program at Chalmette. New process units were installed and existing units were expanded, modified, or converted. Capacity was increased about 40 percent to 80,000 barrels per day. A new coker upgrades No. 6 fuel oil into middle distillates, naphtha, and gas oil. Solid coke is produced for use in electrodes.

Tenneco, along with Murphy Oil Co., completed arrangements to build a common carrier products pipeline from the Tenneco plant at Chalmette, to Collins, Covington County, Miss. Petroleum and petrochemical products from Tenneco's Chalmette refinery and Murphy's Meraux refinery will be piped to Collins, where the line will connect with terminals of both Plantation Pipeline Co. and Colonial Pipeline Co., which transport products from Texas and southwest Louisiana refineries and chemical plants to markets in the New York area. Completion is scheduled for 1969.

Cities Service Oil Co., at its Lake Charles refinery, was constructing a new sulfuric-acid alkylation unit to replace a similar structure destroyed by fire in 1967. Other construction included two new gas-processing units for the recovery of additional petrochemical feedstocks, and expansion of coker facilities.

Gulf Oil Corp. started construction of a 155,000-barrel-per-day refinery in Plaquemines Parish on the west bank of the Mississippi River about 20 miles south of New Orleans. Completion is scheduled for 1971. Products will be moved primarily to the East Coast through the Colonial pipeline. There will be dock loading facilities and also terminal facilities for motor and rail transportation.

Petrochemicals.—The industry continued to be one of the fastest growing segments of the State's economy, although the growth rate declined somewhat.

At Geismar, Borden Chemical Co. completed an 80-million-gallon-per-year methanol plant expansion, boosting capacity to 160 million gallons per year. Vulcan Materials Co. completed a chlorocarbons plant. Uniroyal Chemical Co. was building a 38-million-pound-per-year ethylene-propylene polymers plant.

In the Baton Rouge area Enjay Chemical Co. completed a 200-million-pound-per-year polyethylene plant. The Pennsylvania Industrial Chemical Corp. completed a hydrocarbon resins plant. Uniroyal Chemical had an ABS latex unit expansion under construction at yearend. Allied Chemical Corp. was constructing a 500- to 600-million-pound-per-year vinyl chloride plant. At Carville, Cos-Mar, Inc., completed a 500-million-pound-per-year styrene monomer plant. Hercules, Inc., completed an 80-million-gallon-per-year methanol plant in Iberville Parish south of Plaquemine. At Plaquemine, The Dow Chemical Co. was expanding ethylene facilities by 300 million pounds per year and building a vinylidene plant. Georgia Pacific was building a new 100-million-pound-per-year phenol plant and a 1,000-ton-per-day methanol plant.

In the New Orleans area, Gulf Oil Corp. completed a 1,000-ton-per-day ammonia plant, and a 600-ton-per-day urea plant. Nitrogen, Inc., completed a 1,000-ton-per-day ammonia plant; Central Farmers Fertilizer Co., and Triad Corp. were each building one. Triad Corp. was also building a 1,200-ton-per-day urea plant. Tenneco Oil Co. at Chalmette completed a 3,000-barrel-per-day aromatics unit, a 100-million-pound-per-year paraxylene unit, and an orthoxylene unit of undisclosed capacity. Union Carbide at Taft added a 50-million-pound-per-year dicyclopentadiene unit, a new 120-million-pound-per-year peracetic acid unit, and a 200-million-gallon-per-year aromatics unit.

In the Lake Charles area, Cities Service Oil Co. completed a 2,600-barrel-per-day benzene plant expansion and a 1,870-ton-per-year butyl rubber plant expansion. Continental Oil Co. completed a 500-million-pound-per-year ethylene plant and also placed on stream the world's largest vinyl chloride monomer plant, rated at 600-million-pounds-per-year. Firestone Rubber and Latex Co. built a 2,500-ton-per-year polybutadiene unit. Hercules, Inc., completed a 30-million-pound-per-year polypropylene plant expansion. Cities Service Oil Co. completed a 25-million-pound-per-year cyclododecatriene and cyclooctadiene plant, a first in the petrochemical industry.

In northeastern Louisiana at Sterlington, Commercial Solvents Co. finished construction of a 100-million-gallon- per-year methanol plant.

NONMETALS

Value of nonmetals increased 10.5 percent to $289 million and was 6.7 percent of the State total mineral value.

Barite.—Crude barite, principally from Arkansas, Georgia, Missouri, and various foreign countries, was crushed and ground at three plants at New Orleans and one at Lake Charles. Output was used mainly as a weighting agent in oil-well drilling fluids. Production was up 16 percent from 1967 levels.

Cement.—Portland cement was produced at four Louisiana plants—one near Lake Charles, one at Baton Rouge, and two at New Orleans. Production was down 7 percent from that in 1967. Ready-mix concrete companies were the chief consumers, followed by highway contractors, concrete products manufacturers, and other contractors.

Due to plant obsolescence and low profit margin, Lone Star Cement Corp. closed its Lake Charles plant at the end of April.

Clays.—Production decreased again in 1968. Seven brick companies at eight plants, two lightweight aggregate companies, and three cement companies used clay. The Louisiana Geological Survey continued a joint program with the U.S. Bureau of Mines in making a statewide survey of Louisiana clay types and reserves.

Table 16.—Miscellaneous clay sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	780	$797
1965	909	936
1966	1,005	983
1967	995	1,260
1968	863	1,163

Gypsum.—Winn Rock, Inc., Winn Parish, mined crude gypsum for use as a retarder in portland cement. National Gypsum Co. at Westwego, and United States Gypsum Co. at New Orleans, calcined imported crude gypsum and manufactured wallboard.

Lime.—Production was 3 percent greater than in 1967. Four companies produced lime—Olin Mathieson Chemical Corp. in Calcasieu Parish and Allied Chemical Corp. in East Baton Rouge Parish produced lime for their own use; United States Gypsum Co. in Orleans Parish and Pelican State Lime Co. in St. Mary Parish produced primary lime from oystershell for sale on the open market. The lime was used principally at chemical and industrial plants and for refractories. Regenerated lime was produced by five companies at six plants as follows: Calcasieu Paper Co., Allen Parish; Olin Kraft, Inc., Ouachita Parish; Continental Can Co., Inc., Jackson Parish; International Paper Co., Morehouse and Webster Parishes; and Crown Zellerbach Corp., Washington Parish. Regenerated lime production in 1968 was 498,000 short tons (457,000 in 1967).

Salt.—Louisiana was the Nation's leading salt-producing State. Production was up 14 percent. Demand for rock salt and brine increased substantially, but evaporated salt demand decreased slightly. Evaporated and/or rock salt was produced by six salt companies; brine was produced by seven chemical companies. Salt was used in tanning; food processing; manufacture of rubber, paper, chemicals, livestock feed; snow and ice removal; and numerous other industrial applications.

Table 17.—Salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Evaporated salt		Rock salt		Brine		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1964	252	$6,080	2,516	$16,537	3,633	$13,439	6,401	$36,056
1965	256	6,293	3,016	17,828	4,854	17,691	8,126	41,812
1966	267	6,354	3,502	19,681	4,967	18,154	8,736	44,189
1967	301	7,619	4,183	22,131	5,101	18,733	9,585	48,483
1968	293	7,183	4,793	26,556	5,822	20,115	10,908	53,854

Sand and Gravel.—Production was 20.4 million tons (7.4 million tons of sand and 13.0 million tons of gravel) only about 0.5 percent more than in 1967. A total of 96 sand and gravel operations was reported in 20 parishes. The Louisiana Geological Survey continued a study of Louisiana sands from the standpoint of suitability for industrial use—glass manufacture, foundry sand, etc. The study will be expanded to include detailed work on the Sparta Formation in north Louisiana. Results are to be published.

Stone.—Production consisted primarily of shell (clam and oyster) and some anhydrite produced in Winn Parish for use in road surfacing and in concrete. Total output of shell was about 24 percent higher than in 1967. About 73 percent of the shell was crushed for use as concrete aggregate and for road construction. The remainder was used for manufacture of cement and lime. At yearend Louisiana State University (LSU) researchers announced they would analyze the economics of Louisiana's shell industry for the State Wildlife and Fisheries Commission. The LSU research team will compile a brief story of the industry, analyze production, method of leasing, effects of changes on both the dredgers and the leasers, marketing methods, competition, and importance of the industry to the State's economy. They will present their findings in 1969.

Sulfur.—The sulfur shortage ended in 1968. Louisiana remained the leading sulfur-producing State. Production increased 4.8 percent, and total value rose 16.4 percent to new records. Three new Frasch mines were brought into operation. Free-

Table 18.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	13,228	$14,959	366	$294	13,594	$15,253
1965	14,024	16,306	274	99	14,298	16,405
1966	18,171	22,459	45	45	18,216	22,504
1967	20,216	27,346	96	96	20,312	27,442
1968	20,208	26,354	203	150	20,411	26,504

Table 19.—Sand and gravel sold or used by producers, by classes of operations, and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	5,097	$6,070	4,988	$5,027
Paving	3,654	4,703	2,129	2,135
Other [1]	260	472	291	1,129
Total	9,011	11,245	7,408	8,291
Gravel:				
Building	6,174	8,799	8,575	11,321
Paving	4,848	7,073	4,042	6,485
Other [2]	183	229	183	257
Total	11,205	16,101	12,800	18,063
Total sand and gravel	20,216	27,346	20,208	26,354
Government-and-contractor operations: Gravel: Paving	96	96	203	150
Grand total	20,312	27,442	20,411	26,504

[1] Includes fill, other construction, and industrial sand (ground and unground).
[2] Includes fill and other construction.

port Sulphur Co.'s offshore Caminada facility was the largest; production began in March. Jefferson Lake Sulphur Co. also began production in March at Lake Hermitage Dome. In May, Texas Gulf Sulphur Co. commenced output at its Bully Camp mine.

Because of increased capacity and decreased fertilizer demand, primary producers were able to terminate allocation programs, which had been operative during the shortage.

Late in August, Freeport Chemical Co., a division of Freeport Sulphur Co., brought on stream its phosphoric acid plant at Uncle Sam, La., on the Mississippi River between New Orleans and Baton Rouge. Phosphoric acid used in the manufacture of finished fertilizers is made by reacting phosphate rock (from Florida) with sulfuric acid produced at the plant. Sulfuric acid capacity was 1,680,000 tons per year.

Table 20.—Sulfur produced and shipped from Frasch mines

(Thousand long tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1964	2,739	2,733	$54,996
1965	3,582	3,577	81,372
1966	4,085	4,018	104,472
1967	4,059	4,233	139,739
1968	4,255	4,074	162,664

Sulfur consumption and production are expected to increase in 1969. The outlook for the fertilizer industry is for increased production; higher nonfertilizer use is expected due to expanding industrial activity.

The Department of the Interior announced a 1969 sale of Louisiana Outer Continental Shelf Sulfur leases. In 1967 the industry paid $34 million for offshore Texas leases but failed to find any commercial sulfur deposits. The last Louisiana lease sale was held in 1954.

METALS

Aluminum.—Kaiser Aluminum & Chemical Corp. produced alumina at Gramercy and Baton Rouge, and produced aluminum at Chalmette, the Nation's largest aluminum reduction plant. Bauxite, the primary raw material used by the industry, is not mined in Louisiana; however, the aluminum industry has significantly influenced mineral activity in the State. Kaiser Aluminum & Chemical Corp. employ several thousand people and furnish a market for many of the minerals produced in the State. An expansion program virtually completed at the Gramercy chemicals complex, will triple capacity to produce caustic soda, used in the production of alumina.

Ormet Corp., owned jointly by Olin Mathieson Chemical Corp. and Revere

Copper & Brass, Inc., produced alumina at its Burnside plant.

Gulf Coast Aluminum Corp. continued work on its aluminum and carbon electrode manufacturing facilities at Lake Charles. Gulf Coast is a subsidiary of Swiss Aluminium, Ltd., Zurich, Switzerland, a worldwide producer of primary aluminum. The facility will incorporate a coke calcining plant to produce annually 200,000 tons of calcined coke, 126,000 tons of baked carbon electrodes, and 35,000 tons of primary aluminum. It is expected to be in operation early in 1971. A major portion of the financing was a $62.7 million industrial revenue bond issue by Calcasieu Parish, which will own the facility and lease it to the aluminum company.

Table 21.—Principal producers

Commodity and company	Address	Type of activity	Parish
Barite:			
Dresser Minerals	Houston, Tex	Grinding plant	Orleans and Calcasieu.
Milchem, Inc	do	do	Orleans.
National Lead Co	do	do	Do.
Cement:			
Ideal Cement Co., Portland Cement Div.	Denver, Colo	Plant	East Baton Rouge.
Lone Star Cement Corp	Dallas, Tex	do	Calcasieu and Orleans.
Louisiana Cement Co	New Orleans, La	do	Orleans.
Clay:			
Acme Brick Co	Fort Worth, Tex	Mine and plant	East Baton Rouge.
Athens Caddo Brick Co	Athens, Tex	do	Caddo.
Big River Industries, Inc	Baton Rouge, La	do	Pointe Coupee.
Lone Star Cement Corp	Dallas, Tex	do	Calcasieu.
Louisiana Cement Co	New Orleans, La	do	St. Bernard.
Ideal Cement Co	Denver, Colo	do	West Baton Rouge.
Louisiana Lightweight Aggregate Co.	Alexandria, La	do	Rapides.
Gypsum:			
National Gypsum Co	Buffalo, N.Y	Calcining plant	Jefferson.
United States Gypsum Co	Chicago, Ill	do	Orleans.
Winn Rock, Inc	Winnfield, La	Open pit	Winn.
Lime:			
Allied Chemical Corp	Morristown, N.J	Plant	East Baton Rouge.
Olin Mathieson Chemical Corp	New York, N.Y	do	Calcasieu.
Pelican State Lime Corp	Morgan City, La	do	St. Mary.
U.S. Gypsum Co	Chicago, Ill	do	Orleans.
Salt:			
Allied Chemical Corp	Morristown, N.J	Brine wells	Iberville.
The Carey Salt Co	Hutchinson, Kans	Underground mine	St. Mary.
Cargill, Inc	Minneapolis, Minn	do	Do.
Diamond Crystal Salt Co	St. Clair, Mich	do	Iberia.
The Dow Chemical Co	Midland, Mich	Brine wells	Iberville.
Freeport Sulphur Co	New Orleans, La	do	Jefferson, Plaquemines, Terrebonne.
Gordy Salt Co., Inc	New Iberia, La	do	St. Martin.
International Salt Co	Clarks Summit, Pa	Underground mine	Iberia.
Kaiser Aluminum & Chemical Corp.	Washington, D.C	Brine wells	Ascension.
Morton Salt Co	Chicago, Ill	Underground mine	Iberia.
Olin Mathieson Chemical Corp.	Stanford, Conn	Brine wells	Cameron.
PPG Industries, Inc	Lake Charles, La	do	Calcasieu.
Wyandotte Chemical Corp	Wyandotte, Mich	do	Ascension.
Sand and gravel:			
Braswell Sand and Gravel Co., Inc.	Minden, La	Stationary	Webster.
Gifford-Hill and Co., Inc	Dallas, Tex	do	Do.
Do	do	Dredge	Evangeline and Jefferson Davis.
Holloway Gravel Co., Inc	Baton Rouge, La		East Feliciana.
Jahncke Service, Inc	New Orleans, La	Dredge	St. Tammany.
Louisiana Industries, Inc	do	Stationary	Rapides.
Do	do	Dredge	Washington and Ouachita.
Louisiana Sand and Gravel Co	Baton Rouge, La	do	East Baton Rouge.
Mid-State Materials, Inc	Alexandria, La	do	Rapides.
Northwest Mining Corp	Coushatta, La		Red River.
Ouachita Gravel Co., Inc	Monroe, La	Stationary	Ouachita.
Red Stick Gravel Co	Baton Rouge, La		East Baton Rouge.
Standard Gravel Co., Inc	Franklinton, La	Stationary	Washington.
Trinity Concrete Prod. Co	Longville, La	Stationary and dredge.	Beauregard and Jefferson Davis.
Shell:			
Ayers Materials Co., Inc	Harvey, La	Dredge	St. Tammany.
Ideal Cement Co	Denver, Colo	do	St. Mary.
Jahncke Service Co., Inc	New Orleans, La	do	St. John the Baptist and St. Tammany.
Lake Charles Dredging Co	Lafayette, La	do	Various.
Louisiana Materials Co	New Orleans, La	do	St. Tammany.
Radcliff Materials, Inc	Morgan City, La	do	St. Mary and St. Tammany.
Stone: Winn Rock, Inc	Winfield, La	Quarry and plant	Winn.
Sulfur, native:			
Freeport Sulphur Co	New York, N.Y	Frasch process	Jefferson, Plaquemines, Terrebonne.
Jefferson Lake Sulphur Co	New Orleans, La	do	Plaquemines.
Texas Gulf Sulphur Co	New York, N.Y	do	Lafourche.
Union Texas Petroleum	Sulphur, La	do	Calcasieu.
U.S. Oil of Louisiana, Ltd	Thibodaux, La	Frasch process	Lafourche.
Sulfur, byproduct:			
Shell Oil Co	New Orleans, La	Secondary recovery	St. Charles.
Stauffer Chemical Co	New York, N.Y	do	East Baton Rouge.
Vermiculite, exfoliated: Zonolite Div., W. R. Grace & Co.	Cambridge, Mass	Exfoliation plant	Orleans.

The Mineral Industry of Maine

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Maine, for collecting information on all minerals except fuels.

By Robert E. Ela [1]

Value of mineral production in Maine reached a new high of $17.8 million in 1968, surpassing the previous record set in 1965. Increased output and value was recorded for feldspar, masonry cement, sand and gravel, and stone but production of peat and shipments of portland cement declined.

Continuing growth of the mineral industry was anticipated, as both domestic and foreign mining companies continued to show interest in the investigation and development of the State's mineral deposits including marine research and exploration of the Continental Shelf.

An important addition to the State's mineral industry occurred in March, when the Penobscot Unit of Callahan Mining Co. shipped the first copper and zinc concentrates from its new facility at Harborside.

Spooner Mines and Oil, Ltd., of Toronto, continued geophysical and geochemical exploration for copper and molybdenum in and around the Capheart Mountain area. The Humble Oil & Refining Co., Houston, Tex., entered into an agreement with Spooner for further exploration of 641 square miles in the north mineral belt.

The nickel exploration program conducted by Knox Mining Co., near Union, was in its final stages and was nearing completion.

Noranda Mines, Ltd., of Toronto, through its subsidiary, East Range Co., continued exploration and drilling of the copper-molybdenum deposit on Capheart Mountain, south of Jackman.

The Black Hawk Mining Corp. mine in Blue Hill remained inactive and in standby condition until economic and employment conditions become more favorable.

Groundbreaking ceremonies were held in Wiscasset for Maine Yankee's $121 million nuclear power station. The station, rated at 855,000 kilowatts, will be New England's largest generating unit and is expected to be in commercial operation by mid-1972.

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[1] Supervisory statistical assistant, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Maine [1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Clays .... thousand short tons	42	$54	[2] 42	[2] $65
Gem stones	NA	85	NA	85
Sand and gravel .... thousand short tons	11,627	5,368	11,866	5,978
Stone .... do	1,159	2,999	1,187	3,205
Value of items that cannot be disclosed: Cement (portland and masonry), fire clay (1968), copper (1968), feldspar, peat, silver (1968), and zinc (1968)	XX	6,426	XX	8,527
Total	XX	14,882	XX	17,810
Total 1957-59 constant dollars	XX	14,852	XX	p 16,549

p Preliminary. NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fire clay; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Maine, by counties

(Thousand dollars)

County	1967	1968	Minerals produced in 1968 in order of value
Androsoggin	$425	$520	Sand and gravel, clays, stone.
Aroostook	1,279	909	Sand and gravel, stone.
Cumberland	1,025	1,491	Sand and gravel, stone, clays.
Franklin	218	W	Sand and gravel.
Hancock	527	W	Zinc, copper, sand and gravel, stone, silver, clays.
Kennebec	376	610	Sand and gravel, stone.
Knox	W	W	Cement, stone, sand and gravel.
Lincoln	98	122	Sand and gravel.
Oxford	242	286	Sand and gravel, feldspar.
Penobscot	680	734	Sand and gravel.
Piscataquis	W	W	Stone, sand and gravel.
Sagadahoc	W	W	Sand and gravel.
Somerset	343	367	Sand and gravel, stone.
Waldo	193	320	Sand and gravel.
Washington	W	W	Sand and gravel, peat.
York	W	W	Sand and gravel, stone.
Undistributed [1]	9,476	12,450	
Total [2]	14,882	17,810	

W Withheld to avoid disclosing individual company confidential data.

[1] Includes value of gem stones and sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Maine business activity

	1967	1968	Change, percent
Employment and labor force, annual average:			
Total labor force ... thousands	388.2	394.4	+1.6
Unemployment ... percent of work force	3.9	4.1	+5.1
Employment:			
Manufacturing employment ... thousands	116.3	118.0	+1.5
Durable goods ... do	33.7	32.9	−2.4
Lumber and wood products ... do	14.5	14.5	.0
Nondurable goods ... do	84.3	83.4	−1.1
Food products ... do	12.4	12.5	+.8
Textile mill products ... do	12.5	12.4	−.8
Paper and allied products ... do	18.8	18.0	−4.3
Leather and leather products ... do	29.6	30.7	+3.7
Nonmanufacturing ... do	200.6	205.7	+2.5
Agricultural ... do	16.2	15.4	−4.9
Personal income:			
Total ... millions	$2,585	$2,788	+7.8
Per capita	$2,632	p $2,857	+8.5
Construction activity: New housing units authorized	2,594	2,576	−.7
Cement shipments to and within Maine [1] ... thousand 376-pound barrels	1,043	1,079	+3.5
Mineral production ... thousands	$14,882	$17,810	+19.7

p Preliminary.

[1] Includes portland and masonry cement.

Source: Bureau of Employment Security from ES–219E, Employment & Earnings, U.S. Department of Labor.

Survey of Current Business, U.S. Department of Commerce.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Nonfatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1967:								
Metal and peat	68	241	16	131	----	1	7.63	229
Nonmetal	107	215	23	184	----	5	27.12	602
Sand and gravel	1,490	163	243	2,087	----	39	18.69	373
Stone	466	216	101	819	1	15	19.54	8,342
Total	2,131	180	383	3,221	1	60	18.94	2,405
1968:[p]								
Metal and peat	80	295	23	162	----	6	36.93	535
Nonmetal	85	219	18	148	----	3	20.29	162
Sand and gravel	1,435	167	241	2,084	----	42	20.15	461
Stone	410	216	89	726	----	18	24.79	705
Total	2,010	185	371	3,121	----	69	22.11	507

[p] Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Dragon Cement Co., Division of Martin Marietta Corp., the sole cement producer in Maine, produced both finished portland and masonry cements at Thomaston. Cement rock, the principal raw material consumed in the two-rotary-kiln plant, was quarried locally by the company. Purchased sand, gypsum, and iron-bearing materials were also used as raw materials. Total cement shipments remained about the same as in the previous year. Eighty percent of the portland cement was shipped in bulk to consumers in Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. Total apparent consumption of portland cement in Maine during 1968 was 1,017,000 barrels. In order of size, the principal consumers of finished portland cement were ready-mixed concrete companies, concrete product manufacturers, and building material dealers.

Martin Marietta Corp., announced it was undertaking a major plant construction and facility expansion at Thomaston. The plan includes construction of a new single kiln plant having a capacity of 2.5 million barrels. The present 2-million-barrel production unit, which has been in operation since 1927, will be razed. Construction of the new facility is scheduled to begin early in 1969 and is expected to be completed in June of 1970. The new plant, it was reported, will utilize the most advanced air-pollution abatement equipment.

Clay.—Production of clay, predominantly miscellaneous clay, was slightly more than in 1967. Miscellaneous clay recovered from two pits in Androscoggin County and three in Cumberland County, was used to manufacture building brick. A small quantity of stoneware clay was recovered by Rowantrees Inc., kiln from the area surrounding Blue Hill in Hancock County. The clay was blended with various ingredients to produce informal dinnerware and pottery which has gained an international reputation.

Feldspar.—Production of marketable crude ore, confined to Oxford County, rose nearly 60 percent over that of the previous year, reversing a downward trend which began in 1966. All crude ore was processed at West Paris, Oxford County, by Bell Minerals Co. Production of ground feldspar including high potash feldspar mined in New Hampshire, was 41 percent higher than in the previous year. Output was used chiefly for ceramic materials, although a limited quantity was consumed for soaps and abrasives. The ground feldspar was shipped chiefly to consumers in Pennsylvania, New York, Massachusetts, and Ohio. Smaller quantities were shipped to other States, and some was exported to Canada.

Gem Stones.—Oxford County continued to be the chief area for collecting gem-quality stones and mineral specimens in Maine. Mineral localities, consisting primarily of old mines, quarries, and dumps, continued to attract large numbers of gem and mineral collectors. Various minerals collected included agate, autunite, beryl, gem-quality aquamarine, lithium minerals, and amethyst.

Lime.—High-calcium quicklime was produced and consumed to manufacture paper by Oxford Paper Co., Rumford, Oxford County; S. D. Warren Co., Division of Scott Paper Co., Westbrook, Cumberland County; and Georgia-Pacific Corp., Woodland, Washington County. The companies regenerated and reused their lime, and purchased lime from outside sources only to make up losses.

Nitrogen Compounds.—Anhydrous ammonia used as a fertilizer component was produced by Northern Chemical Industries, Searsport, Waldo County.

Peat.—Despite the increased demand for peat, production continued to decline. All peat sold during the year was the sphagnum variety, and was used principally as a soil conditioner. Operators in Washington County continued to be the principal suppliers of peat. Richland Peat Corp., Penobscot, Hancock County, which undertook a rebuilding program in 1965, discontinued all operations and sold the plant to the Small Business Administration.

Sand and Gravel.—Production of sand and gravel totaled 11.9 million tons, 2 percent higher than in 1967. The increase in output was attributed to the continued expansion of the interstate highway systems between Augusta and Brunswick and for road maintenance. Greater demand for coarse aggregate reflected the various phases of highway construction. The Maine State Highway Commission, the State's largest single user of sand and gravel reported production of paving sand and gravel in all counties; output was obtained both by the Commission's own crews and by workers under contract.

Commercial production representing 23 percent of the State total was reported from all counties except Lincoln and Piscataquis.

Combined production of both commercial and Government-and-contractor operations exceeded 1 million tons in only three counties.

The Counties of Cumberland, Aroostook, Penobscot, York and Androscoggin, in order of decreasing output, accounted for more than half of the State production.

Of the 72 sand and gravel operations classified as commercial, only one produced over 200,000 tons; four produced between 100,000 and 200,000 tons each; 12 between 50,000 and 100,000 tons each; 17 ranged between 25,000 and 50,000 tons each; and 38 produced less than 25,000 tons each.

Stone.—In terms of value, dimension granite and crushed limestone continued to be the principal types of stone quarried in the State. Stone production remained at the 1967 level, and totaled 1,187,000 tons. Value of stone rose $206,000, largely because of the higher unit value of crushed miscellaneous stone and crushed limestone. Miscellaneous stone quarried by Blue Rock Quarry, near Westbrook, was used as coarse concrete aggregate and bituminous aggregate. Crushed and broken limestone was used principally in the manufacture of cement with sizable quantities being used for concrete, roadstone, and agricultural purposes. The principal limestone-producing area was Knox County followed by Aroostook and Kennebec Counties. Dimension granite was produced in Hancock, Knox, and York Counties. Output of dimension granite, in order of decreasing value, included rough and dressed architectural, curbing, rubble, and dressed stone for construction.

A fire which occurred early in the year severely curtailed production at Hocking Granite Industries, Inc., located near St. George, Knox County. The John Swenson Granite Co., Inc., completed development of its new Tatnic Black Quarry near North Berwick in York County and resumed granite quarrying, after more than 30 years, on Vinalhaven Island. The gray granite being quarried at Vinalhaven will complement the black granite quarried near North Berwick and the green and pink granites being quarried. near York.

Slate production, exclusive to Piscataquis County, was mined underground by Portland-Monson Slate Co.

METALS

The Penobscot unit of Callahan Mining Corp. at Harborside was officially opened in February, following nearly 4 years of exploration, construction, and preproduction work and an overall expenditure of approximately $4.5 million. The open pit

Table 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	252	$201	267	$239
Paving	246	222	331	321
Fill	259	125	432	155
Other [1]	122	77	103	83
Total	879	625	1,133	798
Gravel:				
Structural	211	215	174	170
Paving	672	807	931	1,026
Fill	126	69	284	125
Other [2]	188	142	242	151
Total	1,197	1,233	1,631	1,472
Total sand and gravel	2,076	1,858	2,764	2,270
Government-and-contractor operations:				
Sand:				
Paving	1,957	738	410	164
Other	268	109	120	41
Total	2,225	847	530	205
Gravel:				
Paving	7,320	2,661	8,567	3,501
Fill	3	1	5	2
Other	3	1	--------	--------
Total	7,326	2,663	8,572	3,503
Total sand and gravel [3]	9,551	3,510	9,102	3,711
All operations:				
Sand	3,104	1,472	1,663	1,003
Gravel	8,523	3,896	10,203	4,975
Total	11,627	5,368	11,866	5,978

[1] Includes railroad ballast (1967), engine, and other sands.
[2] Includes miscellaneous, other, and railroad ballast gravel.
[3] Data may not add to totals shown because of independent rounding.

mine is the first base metal mining operation of significance in the State since the turn of the century. The flotation mill was among the first to use sea water for processing. Tailings from the mill are impounded and the water decanted and returned to the ocean. The company was required to remove 13 tons of waste for every ton of ore. Approximately 112,000 tons of ore was milled to produce more than 10,000 tons of zinc concentrates, and 4,500 tons of copper concentrate, during the year. Zinc concentrates were shipped to St. Joseph Lead Co. at Josephtown, Pa., and the copper concentrates to the Noranda Co. at Gaspé, Quebec. Land disturbed by construction and development was contoured and seeded as part of their rehabilitation program. Continuing exploration by Callahan Mining Co. had located a promising deposit not far from its present open-pit operation.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement: Dragon Cement Co., Division of Martin Marietta Corp. [1]	5A Joyce Kilmer Ave. New Brunswick, N.J. 08901	Plant	Knox.
Clay:			
Dennis Brick Co., Inc	R.F.D. No. 1 38 Old Washington Rd. Auburn, Maine 04210	Pit	Androscoggin.
Lachance Bros. Brick Co	R.F.D. No. 2 Gorham, Maine 04038	Pit	Cumberland.
Fred S. Liberty & Son, Inc	R.F.D. No. 1 Gray, Maine 04039	Pit	Do.
Morin Brick Co	Danville, Maine 04223	Pit	Androscoggin.
Rowantrees, Inc	Blue Hill, Maine 04614	Pit	Hancock.
Royal River Brick Co., Inc	Box 191, Gray, Maine 04039	Pit	Cumberland.
Feldspar (crude):			
Bell Minerals Co	West Paris, Maine 04289	Pit [2]	Oxford.
Albert Herrick	do	Pit	Do.
Frank Perham	do	Pit [2]	Do.
Lime (regenerated):			
Georgia-Pacific Corp	Woodland, Maine 04694	Plant	Washington.
Oxford Paper Company	Rumford, Maine 04276	do	Oxford.
Warren Company, S.D	Westbrook, Maine 04092	do	Cumberland.
Peat:			
Eric W. Kelley Peat Moss Co., Inc.	Centerville, Maine 04000	Bog	Washington.
New England Peat Industries, Inc.	Mason's Bay Road Jonesport, Maine 04649	do	Do.
Sand and gravel:			
Blue Rock Sand & Gravel	58 Main Street Westbrook, Maine 04092	Pit	Androscoggin.
Philip R. Boston, Inc	Elm Street North Berwick, Maine 03906	Pit	York.
Harry C. Crooker & Sons, Inc.	Brunswick, Maine 04011	Pit	Cumberland.
Cumberland Sand & Gravel Co., Inc.	Box 288, Portland, Maine 04100	Pit	Do.
I.H. Fenderson, Inc	North St., Saco, Maine 04072	Pit	York.
Hamlin Sand & Gravel Co., Inc.	920 Riverside St. Portland, Maine 04103	Pit [3]	Cumberland.
Lane Construction Co	965 East Maine St. Meriden, Conn. 06450	Pit	Aroostook.
Lane Construction Co	do	Pit	Penobscot.
Lewiston Crushed Stone Co., Inc.	South Ave. Lewiston, Maine 04240	Pit	Androscoggin.
Harold MacQuinn, Inc	Hull Cove Bar Harbor, Maine 04609	Pit	Hancock.
Presque Isle Sand & Gravel Co.	Presque Isle, Maine 04769	Pit	Aroostook.
Leroy S. Prout Sand & Gravel.	Scarborough, Maine 04074	Pit	Cumberland.
Maynard W. Robinson & Sons.	R.F.D. No. 2 Cumberland Center, Maine 04021	Pit	Do.
Frank Rossi & Sons, Inc	National Bank Bldg. Gardiner, Maine 04345	Pit	Various.
Warren Bros. Roads Co	Fairfield, Maine 04937	Pit	Kennebec.
Stone:			
Granite, dimension:			
Deer Island Granite Corp	Stonington, Maine 04681	Quarry	Hancock.
Hocking Granite Industries, Inc. [4]	Saint George, Maine 04857	do	Knox.
Joseph Musetti	Mount Desert, Maine 04660	do	Hancock.
The John Swenson Granite Co., Inc.	North State St. Concord, N.H. 03301	do [5]	York, Knox.
Granite, crushed: Cook & Co., Incorporated.	960 Ocean Ave. Portland, Maine 04103	Quarry	Cumberland.
Limestone, crushed:			
Blue Rock Quarry [6]	58 Main St. Cumberland Mills, Maine 04092	do	Kennebec.
Dragon Cement Co., Division of Martin-Marietta Corp.	5A Joyce Kilmer Ave. New Brunswick, N.J. 08901	do	Knox.
Lime Products Corporation.	P.O. Box 357 Union, Maine 04862	do	Do.
McKay Rock Products, Inc. [7]	Box 656, Reach Road Presque Isle, Maine 04769	do	Aroostook
Rockland-Rockport Lime Co.	Rockland, Maine 04841	do	Knox.
Slate, dimension: Portland-Monson Slate Co.	Middle Granville, N.Y. 12849	Underground	Piscataquis.
Zinc: Callahan Mining Corp [8]	Harborside, Maine 04642	do	Hancock.

[1] Portland and masonry.
[2] 2 mines.
[3] 3 pits.
[4] Also crushed.
[5] Includes 4 quarries: 3 in York (Pink, Green, and Black) and 1 in Knox (Gray).
[6] Also crushed miscellaneous.
[7] Also sand and gravel.
[8] Also copper and silver.

The Mineral Industry of Maryland

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Maryland Geological Survey for collecting information on all minerals except fuels.

By Curtis D. Edgerton [1]

The total value of mineral production in Maryland dropped to $71.8 million, about $1 million less than that in 1967. The leading commodity continued to be stone, which accounted for 37 percent of the total value of all minerals produced. Sand and gravel made up 24 percent of total value, and cement contributed significantly to the value of minerals produced. Leading producing counties were Baltimore, Carroll, Frederick, Prince Georges, and Washington. The value of mineral production from these counties accounted for more than half of the State total.

The Maryland Geological Survey continued basic and environmental geologic mapping in the Baltimore area, revised the topographic maps of Washington and Queen Annes Counties, and cooperated with the U.S. Geological Survey in basic geologic mapping of Cecil County. In addition, the two agencies cooperated in aeromagnetic mapping of Kent and Cecil Counties.

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[1] Geologist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Maryland [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays .... thousand short tons..	998	$1,462	[2] 1,078	[2] $1,252
Coal (bituminous) .... do....	1,305	4,548	1,447	5,318
Gem stones	NA	3	NA	3
Natural gas .... million cubic feet..	621	159	864	221
Peat .... short tons..	W	W	5,554	94
Sand and gravel .... thousand short tons..	12,868	17,724	11,719	17,157
Stone .... do....	14,479	28,581	13,344	26,606
Value of items that cannot be disclosed: Ball and fire clay (1968), cement (portland and masonry), greensand marl, lime, potassium salts, talc and soapstone, and values indicated by symbol W	XX	20,342	XX	21,193
Total	XX	72,819	XX	71,844
Total 1957–59 constant dollars	XX	[r] 70,776	XX	[p] 69,104

[r] Revised. [p] Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes ball and fire clay; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Maryland, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968, in order of value
Allegany	$2,659	$2,727	Coal, sand and gravel, stone, clays.
Anne Arundel	2,653	2,675	Sand and gravel.
Baltimore	14,035	12,880	Stone, sand and gravel, clays.
Calvert	W	W	Greensand marl, sand and gravel.
Caroline	W	W	Sand and gravel.
Carroll	W	W	Cement, stone, clays, soapstone.
Cecil	3,689	3,401	Stone, sand and gravel.
Charles	W	W	Sand and gravel.
Dorchester	W	73	Do.
Frederick	7,986	8,256	Cement, stone, clays, lime, sand and gravel.
Garrett	r 3,685	4,538	Coal, stone, natural gas, sand and gravel, peat.
Harford	1,670	1,479	Stone, sand and gravel, clays, talc.
Howard	W	W	Stone.
Kent	W	W	Peat, clays.
Montgomery	W	W	Stone, sand and gravel.
Prince Georges	7,599	6,720	Sand and gravel, clays.
St. Marys	W	W	Sand and gravel.
Talbot	W	W	Do.
Washington	W	W	Cement, stone, clays, potassium salts.
Wicomico	W	W	Sand and gravel.
Worcester	W	W	Do.
Undistributed[2]	r 28,845	29,097	
Total[3]	72,819	71,844	

r Revised. W Withheld to avoid disclosing individual company confidential data.

[1] Queen Annes and Somerset Counties are not listed because no production was reported.

[2] Includes some sand and gravel that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Maryland business activity

	1967	1968	Change (percent)
Employment and labor force, annual average:			
Total labor force .... thousands	1,370.6	1,416.7	+3.4
Unemployment .... (percent of labor force)	3.1	3.2	+3.2
Employment:			
Manufacturing .... thousands	283.3	280.0	−1.2
Durable goods .... do	157.7	153.4	−2.7
Nondurable goods .... do	125.6	126.6	+0.8
Nonmanufacturing .... do	898.4	946.8	+5.4
Mining .... do	1.8	1.8	0.0
Contract construction .... do	79.7	80.7	+1.3
Payroll—average weekly earnings:			
Manufacturing	$114.21	$122.61	+7.4
Durable goods	$127.10	$135.96	+7.0
Nondurable goods	$98.70	$105.87	+7.3
Personal income:			
Total .... millions	$12,959	$13,933	+7.5
Per capita	$3,423	p $3,712	+8.4
Construction activity:			
New housing units authorized	31,789	32,507	+2.3
Cement shipments to and within Maryland thousand 376-pound barrels	6,720	6,439	−4.2
Mineral production .... thousands	$72,819	$71,844	−1.3

p Preliminary.

Source: U.S. Department of Commerce, Survey of Current Business and Construction Reports; State of Maryland Department of Employment Security; Bureau of Mines.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Nonfatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1967:								
Coal and peat	350	210	74	596	1	7	13.41	12,529
Nonmetal	430	239	103	847	------	36	42.52	604
Sand and gravel	827	263	217	1,878	2	45	25.03	7,267
Stone	1,095	270	296	2,510	------	57	22.71	453
Total [1]	2,702	255	689	5,830	3	145	25.38	3,905
1968: [p]								
Coal and peat	365	209	77	628	------	7	11.14	323
Nonmetal	155	256	39	313	------	16	51.04	1,215
Sand and gravel	665	263	175	1,522	------	33	21.68	321
Stone	1,075	277	298	2,461	------	59	23.97	481
Total [1]	2,260	261	589	4,925	------	115	23.35	458

[p] Preliminary.

[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Both portland and masonry cement outputs were slightly higher in 1968 than those in the previous year. Plants producing cement were located in Carroll, Frederick, and Washington Counties.

Clays.—Clays were produced in eight of the State's counties. The majority of these clays were classified as miscellaneous clays, which were used in making structural clay products, lightweight aggregate, and portland cement. Fire clay production was reported in Allegany and Harford Counties. This was used in the manufacture of a variety of refractories and structural clay products. Ball clay was produced at an operation in Baltimore County.

Gem Stones.—Production of semiprecious stones was limited to small quantities collected by dealers and amateur collectors. The total value was estimated at not more than a few thousand dolllars.

Lime.—Production of quicklime and hydrated lime was confined to Frederick County, where three plants operated during the year. Most of the production was quicklime used for agricultural purposes. Output was greater in 1968 than that in 1967. A plant in Allegany County regenerated lime.

Marl, Greensand.—A company in Calvert County mined greensand marl which was sold for agricultural purposes.

Perlite.—Three companies, each operating one plant, produced expanded perlite in Baltimore and Prince Georges Counties. The product was marketed for use in building plaster, insulating material, concrete aggregate, as a filtering medium, and as a soil conditioner.

Potassium Salts.—A cement plant in Washington County produced potassium salts as a byproduct which were sold for agricultural purposes.

Sand and Gravel.—Production (commercial and Government-and-contractor) declined 1.1 million short tons to 11.7 million short tons. Commercial sand and gravel comprised about 97 percent of total production. Average value of the commercial product was $1.49 per ton, up $0.10 from the 1967 value. Sixty-two percent of the commercial sand and gravel production was used in building construction; 23 percent was used in paving. The remainder went into fill and for miscellaneous purposes. Seventy operations, consisting of 49 stationary plants, six portable plants, one dredge, and 14 bank-run operations, were active. Counties leading in value of sand and gravel production (not in order of rank) were Allegany, Anne Arundel, Baltimore, Charles, and Prince Georges.

Stone.—Total value of stone declined nearly $2 million to $26.6 million, but stone continued to be the leading commodity in value. Production was reported from 10 counties. Baltimore, Frederick, Montgomery, and Howard Counties yielded about two-thirds of the State's output. Virtually all of the stone produced was sold as crushed and broken stone. Of this, 64 percent was limestone, 29 percent was trap rock, and the remaining 7 percent consisted of quartzite, marble, granite, oystershell, and miscellaneous stone. About 83 percent of all crushed and broken stone was used for construction and maintenance purposes. The rest was used for agricultural purposes, cement manufacture, and metallurgical and other special purposes.

Talc and Soapstone.—Talc was mined and processed in Harford County. The commodity was used in foundry facings and in the manufacture of ceramics and toilet preparations. Soapstone, produced in Carroll County, was ground and sold for roofing granules, as asphalt filler, and for foundry facings.

Vermiculite (Exfoliated).—A company operating in Prince Georges County processed vermiculite and sold the product for use as insulation, in aggregate, for agricultural purposes, and for miscellaneous uses.

MINERAL FUELS

Coal (Bituminous).—Coal was mined from 21 underground mines, seven auger mines, and 33 strip mines located in Allegany and Garrett Counties. Total production was 1,447,000 tons, up 142,000 tons from 1967 production. Strip mines produced 69 percent of the coal; 24 percent was from underground mines, and the remaining 7 percent came from auger mines. Coal mined underground brought an average price of $4.25 per ton, down 20 cents from the 1967 price. Coal from strip mines sold for an average price of $3.64 per ton, an increase of 52 cents. Auger-mined coal declined 36 cents per ton to $2.00.

Coke and Coal Chemicals.—Bethlehem

Table 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	4,130	$5,306	4,459	$6,443
Paving	1,900	2,711	1,278	1,967
Other [1]	453	976	402	838
Total	6,483	8,993	6,134	9,248
Gravel:				
Structural	2,724	4,971	2,587	4,522
Paving	2,267	2,931	1,302	1,996
Fill	828	509	W	W
Other [2]	340	202	1,332	1,193
Total	6,154	8,613	5,221	7,711
Total sand and gravel	12,637	17,606	11,355	16,959
Government-and-contractor operations:				
Sand	41	15	182	105
Gravel	190	103	182	93
Total	231	118	364	198
All operations:				
Sand	6,524	9,008	6,316	9,353
Gravel	6,344	8,716	5,403	7,804
Total	12,868	17,724	11,719	17,157

W Withheld to avoid disclosing individual company confidential data.

[1] Includes sand for glass, grinding and polishing, fill, and other uses.

[2] Includes miscellaneous gravel, fill (1968), and other uses (1967).

Steel Corp. produced coke and coal chemicals at Sparrows Point. Coproducts and byproducts included coke breeze, coke oven gas, ammonium sulfate, soft tar pitch, crude tar, crude chemical oil, crude light oil and derivatives, and naphthalene.

Natural Gas and Petroleum.—Natural gas was produced from 15 wells in the Mountain Lake Park and the Negro Mountain fields, both in Garrett County. Near Baltimore, American Oil Co. and Chevron Oil Co. operated one crude petroleum refinery each. Total crude capacity was 20,500 barrels per stream day, the same as that in 1967.

Peat.—One bog each in Garrett and Kent Counties yielded reed-sedge and humus peat. The commodity was processed and sold in bulk or packaged for general soil improvement.

METALS

Copper.—Two plants, one at Baltimore and one at Hawkins Point (Anne Arundel County), refined copper from anodes shipped into the State. Some gold and silver were produced as byproducts.

Iron and Steel.—Bethlehem Steel Corp. produced basic- and off-grade pig iron, steel ingot, and semifabricated products at its Sparrows Point plant.

Lead.—A plant at Baltimore produced lead and other alloys and products from lead remelt, primary metals, and scrap.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Portland:			
Alpha Portland Cement Co.[1]	15 South 3d Street Easton, Pa. 18042	Plant	Frederick.
Lehigh Portland Cement Co.[2]	718 Hamilton Street Allentown, Pa. 18101	do	Carroll.
Marquette Cement Manufacturing Co.[3]	20 North Wacker Drive Chicago, Ill. 60606	do	Washington.
Masonry: M. J. Grove Co., Division of the Flintkote Co.	Lime Kiln, Md. 21763	do	Frederick.
Clays:			
Ball: United Sierra Division Cyprus Mines Corp.	P.O. Box 1201 Trenton, N.J. 08606	Pit	Baltimore.
Fire:			
Kaiser Refractories, Division of Kaiser Aluminum & Chemical Corp.	P.O. Box 363 Frostburg, Md. 21532	Underground	Allegany.
Maryland Clay or William D. Bowman.	R.F.D. 2, Box 303 Aberdeen, Md. 21001	Pit	Harford.
Miscelianeous clay and shale:			
Baltimore Brick Co	501 St. Paul Place Baltimore, Md. 21202	do	Baltimore.
Do	do	do	Frederick.
Champion Brick Co	7600 Pulaski Highway Baltimore, Md. 21237	do	Baltimore.
Chestertown Brick Co	Chestertown, Md. 21620	do	Kent.
Victor Cushwa & Sons, Inc	201 West Potomac Street Williamsport, Md. 21795	do	Washington.
Lehigh Portland Cement Co.[4]	718 Hamilton Street Allentown, Pa. 18101	do	Frederick.
United Brick Corp	2801 New York Avenue, NE. Washington, D.C. 20002	do	Prince Georges.
The Washington Brick Division, Thos. Somerville Co.	6th and Decatur, NE. Washington, D.C. 20002	do	Do.
West Brothers Brick Co	6600 Sheriff Road, NE. Washington, D.C. 20027	do	Do.
Coal:			
Buffalo Coal Co., Inc	Bayard, W. Va. 26707	Strip	Garrett.
Do	do	Underground	Do.
F. & P. Coal Company	Route 1 Masontown, W. Va. 26542	do	Do.
Garrett Coal Corp. for W. R. Nethken & Co., Inc.	P.O. Box 188 Oakland, Md. 21550	Strip	Do.
Do	do	2 underground mines.	Do.
Do	do	Auger	Do.
Ginniman & Ware Coal Co	P.O. Box 182 Barton, Md. 21521	Strip	Allegany.

See footnotes at end of table.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal—Continued			
Ginniman & Ware Coal Co.	P.O. Box 182 Barton, Md. 21521	Strip	Garrett.
Moran Coal Co., Inc	P.O. Box 68 Westernport, Md. 21562	4 strip mines	Do.
Richards & Parnell Coal Co	Friendsville, Md. 21531	Strip	Do.
W. & W. Coal Co	P.O. Box 221 Westernport, Md. 21562	Underground	Allegany.
Do	do	do	Garrett.
Winner Brothers Coal Co	243 Upper Consol Road Frostburg, Md. 21532	Strip	Allegany.
Gypsum (calcined):			
National Gypsum Co.[5]	325 Delaware Avenue Buffalo, N.Y. 14202	Plant	Baltimore.
United States Gypsum Co	101 South Wacker Drive Chicago, Ill. 60606	do	Do.
Greensand marl: Kaylorite Corp	Dunkirk, Md. 20754	Pit	Calvert.
Finished iron oxide pigments (natural and manufactured):			
Mineral Pigments Corp	Washington Boulevard Muirkirk, Md. 20705	Plant	Prince Georges.
Lime:			
S. W. Barrick & Sons, Inc	Woodsboro, Md. 21798	do	Frederick.
LeGore Lime Company	LeGore, Md. 21761	do	Do.
Everett V. Moser	R.F.D. 1 Middletown, Md. 21769	do	Do.
Lime (regenerated): West Virginia Pulp & Paper Co.	Luke, Md. 21562	do	Allegany.
Oystershell: Oyster Shell Company	607 Keyser Building Baltimore, Md. 21202	do	Baltiomre.
Peat:			
Garrett County Processing & Packaging Corp.	R.F.D. 1 Accident, Md. 21520	Bog	Garrett.
Maryland Peat & Humus Co	90 Cricket Avenue Ardmore, Pa. 19003	do	Kent.
Perlite (expanded): Atlantic Perlite Co.	1919 Kenilworth Avenue, NE. Washington, D.C. 20027	Plant	Prince Georges.
Petroleum refineries:			
American Oil Company	Baltimore, Md. 21200	Refinery	Baltimore.
Chevron Asphalt Co	do	do	Do.
Sand and gravel:			
Annapolis Sand & Gravel Co., Inc.	Annapolis Expressway and B & O R.R. Annapolis, Md. 21400	Pit	Anne Arundel.
Arundel Corp	501 St. Paul Place Baltimore, Md. 21202	do	Do.
Arundel Supply Corp	6900 Walker Mill Road Washington, D.C. 20027	do	Prince Georges.
Campbell Sand Co., Inc	4911 Calvert Road College Park, Md. 20740	do	Do.
Harry T. Campbell Sons' Corp	Towson, Baltimore, Md. 21204	do	Baltimore.
Charles County Sand & Gravel Co., Inc.	P.O. Box 322 Waldorf, Md. 20601	do	Charles.
Contee Sand & Gravel Co., Inc	Laurel, Md. 20810	do	Prince Georges.
Forestville Sand & Gravel Co., Inc.	R.F.D. Box 4263 Upper Marlboro, Md. 20870	do	Do.
Inland Materials, Inc	5401 Kirby Road Clinton, Md. 20735	do	Do.
Manley Sand Division, Martin Marietta Co.	P.O. Box 1341 Cumberland, Md. 21502	do	Allegany.
Chas. Meyer & Sons, Inc	Route 1, Box 49 Lothian, Md. 20820	do	Anne Arundel.
Nottingham Properties, Inc	Regester Avenue and Overbrook Road Baltimore, Md. 21212	do	Baltimore.
Potomac Sand & Gravel Co	3020 K Street, NW. Washington, D.C. 20007	Dredge and 3 pits.	Charles.
Silver Hill Sand & Gravel Co	4600 St. Barnabas Road, SE. Washington, D.C. 20031	Pit	Prince Charles.
A. H. Smith Co	Branchville, Md. 20721	do	Do.
Stancills, Inc	P.O. Box 236 Aberdeen, Md. 21001	do	Harford.
York Building Products Co., Inc.	P.O. Box 1708 York, Pa. 17405	2 pits	Cecil.
Smelters:			
American Smelting and Refining Co.	120 Broadway New York, N.Y. 10005	Plant	Baltimore.
Kennecott Refining Corp	161 East 42d Street New York, N.Y. 10017	Refinery	Anne Arundel.

See footnotes at end of table.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Soapstone and talc:			
Harford Talc Co.[6]	Box 527 Bel Air, Md. 21014	Pit	Harford.
Liberty Talc Mines, Inc.[7]	Box 85 Sykesville, Md. 21784	do	Carroll.
Stone:			
Granite, crushed: Maryland Materials, Inc.	P.O. Box 159 Elkton, Md. 21921	Quarry	Cecil.
Limestone:			
Appalachian Stone Division	Box 120 Mercersburg, Pa. 17236	do	Allegany.
Martin Marietta Corp	do	4 quarries	Washington.
The Arundel Corp	501 St. Paul Place Baltimore, Md. 21202	Quarry	Baltimore.
Harry T. Campbell Sons' Corp.	Towson, Baltimore, Md. 21204	Underground mine and 2 quarries.	Do.
M. J. Grove Lime Co., Division of the Flintkote Co.	Lime Kiln, Md. 21763	Quarry	Frederick.
Howard-Montgomery Crushed Stone Co.	Brighton Dam Road Clarksville, Md. 21029	do	Howard.
LeGore Lime Co	Le Gore, Md. 21761	do	Frederick.
Superior Concrete, Inc	Frederick, Md. 21701	do	Do.
Teeter Stone, Division Harry T. Campbell Sons' Corp.	Towson, Baltimore, Md. 21204	do	Carroll.
Marble: The Maryland Green Marble Corp.	Box 1198 Roanoke, Va. 24006	do	Harford.
Miscellaneous (crushed): The Arundel Corp.	501 St. Paul Place Baltimore, Md. 21202	do	Baltimore.
Miscellaneous (dimension): Stoneyhurst Quarries.	7501 Persimmon Tree Lane Bethesda, Md. 20034	Quarry	Montgomery.
Quartzite (crushed): Harbison Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15222	do	Cecil.
Quartzite (dimension): The Weaver Stone Co.	Box 96 Reisterstown, Md. 21136	do	Baltimore.
Sandstone (dimension):			
B & B Stone Co	Grantsville, Md. 21536	do	Garrett.
M & S Stone Quarries	do	do	Do.
Trap rock (basalt), crushed:			
The Arundel Corporation	501 St. Paul Place Baltimore, Md. 21202	do	Baltimore.
Do	do	do	Harford.
Do	do	do	Howard.
Gatch Crushed Stone Co., Inc.	P.O. Box 70–A Bel Air, Md. 21014	do	Harford.
Rockville Crushed Stone, Inc.	P.O. Box 407 Rockville, Md. 20850	do	Montgomery.
D. M. Stoltzfus & Son, Inc	Talmage, Pa. 17580	do	Cecil.
Do	do	do	Harford.
Vermiculite (exfoliated): W. R. Grace & Co. Zonolite Division.[5]	62 Whittemore Avenue Cambridge, Mass. 02140	Plant	Prince Georges.

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[1] Also masonry cement and limestone.
[2] Also masonry cement, limestone, sandstone, shale.
[3] Also masonry cement, limestone, potassium salts.
[4] Lightweight aggregate manufacture.
[5] Also expanded perlite.
[6] Talc.
[7] Soapstone.

The Mineral Industry of Massachusetts

By C. Gordon Leaf [1]

Value of mineral production in Massachusetts increased 6.7 percent in 1968 to a new high of $43.3 million. This increase resulted primarily from an increase in production and value of stone, which together with sand and gravel, represented over 91 percent of the State's total mineral production value. Output of lime and sand and gravel was virtually the same as in the previous year.

Middlesex County was again the leading mineral producing county in the State with $12.6 million, or 29 percent of the total production value. Berkshire County retained second place with over 18 percent of the total value.

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[1] Geologist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Massachussets [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	W	W	257	$314
Gem stones	NA	$2	NA	2
Lime thousand short tons	195	3,044	198	3,380
Sand and gravel do	17,881	19,504	17,799	20,106
Stone do	6,203	17,724	6,917	19,501
Value of items that cannot be disclosed: Nonmetals and values indicated by symbol W	XX	338	XX	37
Total	XX	40,612	XX	43,340
Total 1957–59 constant dollars	XX	39,177	XX	p 41,531

p Preliminary. NA Not available. XX Not applicable.
W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

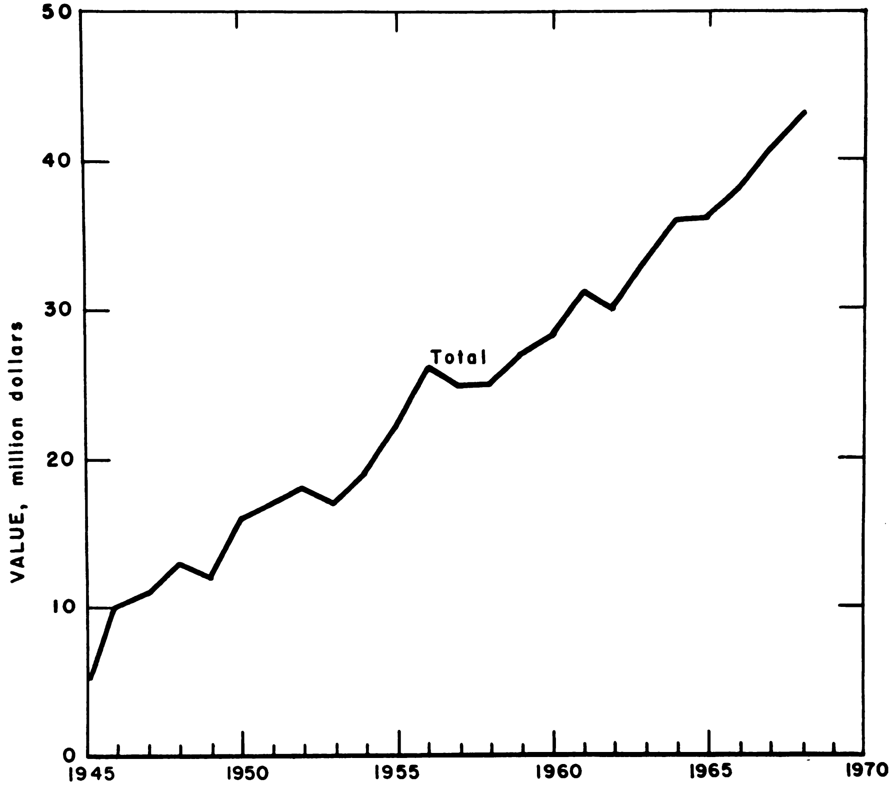

Figure 1.—Total value of mineral production in Massachusetts.

Table 2.—Value of mineral production in Massachusetts, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Barnstable	W	W	Sand and gravel.
Berkshire	$7,667	$8,063	Stone, lime, sand and gravel.
Bristol	3,016	3,211	Sand and gravel, stone.
Dukes	W	W	Sand and gravel.
Essex	3,283	3,107	Stone, sand and gravel, peat.
Franklin	882	951	Sand and gravel, stone.
Hampden	2,844	3,739	Stone, sand and gravel, clays.
Hampshire	708	613	Sand and gravel, stone.
Middlesex	12,084	12,614	Stone, sand and gravel.
Nantucket	10	W	Sand and gravel.
Norfolk	5,016	5,228	Sand and gravel, stone, clays.
Plymouth	615	630	Sand and gravel, clays, stone.
Suffolk	321	453	Stone.
Worcester	2,864	3,657	Sand and gravel, stone, peat.
Undistributed [1]	1,302	1,073	
Total [2]	40,612	43,340	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes gem stones, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Massachusetts business activity

	1967	1968	Change (percent)
Employment and labor force, annual average:			
Total labor force thousands	2470.4	2503.0	+1.3
Unemployment (percent of work force)	4.1	4.1	.0
Employment thousands	2367.6	2396.4	+1.2
Manufacturing do	701.0	690.4	−1.5
Durable goods do	357.1	350.7	−1.8
Primary metals do	23.5	22.4	−4.7
Fabricated metal products do	44.0	43.4	−1.4
Machinery do	79.4	76.4	−3.8
Electrical equipment do	102.7	100.2	−2.4
Transportation equipment do	28.0	26.5	−5.4
Instruments, optical, watches, etc do	31.0	30.9	−.3
Nondurable goods do	343.9	339.7	−1.2
Nonmanufacturing do	1464.3	1509.7	+3.1
Mining and services do	412.4	433.2	+5.0
Construction do	89.3	93.1	+4.3
Payroll: Average weekly earnings (manufacturing)	$108.00	$114.40	+5.9
Personal income:			
Total millions	$19,197	$20,758	+8.1
Per capita	$3,533	p $3,796	+7.4
Construction activity:			
New housing units authorized	27,717	37,315	+34.6
Cement shipments to and within Mass. thousand 376-pound barrels	6,105	6,546	+7.2
Mineral production thousands	$40,612	$43,340	+6.7

p Preliminary.

Sources: U.S. Department of Labor: Employment and Earnings, and Bureau Employment Security Form ES 219E; Construction Reports and Survey of Current Business, U.S. Department of Commerce.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Nonmetal and peat	64	286	18	146	-------	10	68.26	1,406
Sand and gravel	1,016	229	232	1,905	-------	38	19.94	601
Stone	957	267	255	2,059	2	50	25.26	6,496
Total [1]	2,037	249	506	4,111	2	98	24.33	3,583
1968: p								
Nonmetal and peat	70	275	20	158	-------	11	69.42	1,950
Sand and gravel	930	227	211	1,741	-------	32	18.38	892
Stone	915	262	240	1,931	-----	45	23.30	639
Total [1]	1,920	245	471	3,831	-------	88	22.97	809

p Preliminary.

[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—Production and value of clay and shale in Massachusetts was higher than in 1967, with three counties again reporting production. The leading producer was Norfolk County with one company that mined shale for use in manufacturing lightweight aggregate. Plymouth County led in production value with two companies mining clay for use in the manufacture of building brick. One company in Hampden County also produced clay for building brick.

Gypsum.—A plant in Suffolk County manufactured calcined gypsum products from crude gypsum imported from Nova Scotia, Canada.

Lime.—The quantity of lime produced in 1968 increased slightly over that for

1967; the value increased 11 percent. Largest user of lime was the chemical industry which consumed the major portion of the total output. The remainder was used in construction and for agriculture. Three companies, all in Berkshire County, mined limestone and manufactured hydrated lime and quicklime.

Perlite (Expanded).—Two plants in Suffolk County expanded crude perlite mined outside the State. The product was sold for use mainly as lightweight aggregate, as cryogenic insulation, and as a soil conditioner.

Sand and Gravel.—Production and value of sand and gravel in 1968 remained nearly the same as in 1967. Production was down less than 1 percent while a higher unit value accounted for the 3-percent increase in value. Sand and gravel was again the leading mineral commodity produced in the State with $20.1 million, or 46 percent of the total mineral value. Commercial operations produced about 81 percent of the total sand and gravel; Government-and-contractor operations made up the balance.

Commercial production was reported from 228 pits operated by 127 companies in 1968. Middlesex County maintained its

Table 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	3,061	$3,400	2,897	$3,414
Paving	2,461	2,509	2,480	2,661
Fill	678	276	608	287
Molding	118	578	W	W
Blast	7	68	7	65
Filtration	7	18	8	16
Undistributed [1]	595	511	691	1,044
Total	6,927	7,360	6,691	7,487
Gravel:				
Structural	2,973	4,461	2,801	4,470
Paving	3,098	3,416	3,064	3,589
Fill	1,093	699	920	551
Other	132	196	[2] 141	[2] 222
Miscellaneous	504	420	769	615
Total	7,800	9,192	7,695	9,447
Total sand and gravel	14,727	16,552	14,386	16,934
Government-and-contractor operations:				
Sand:				
Paving	23	20	45	34
Other	9	8	11	10
Total	32	28	56	44
Gravel:				
Paving	3,115	2,918	3,354	3,124
Fill	5	3	W	W
Other	2	3	W	W
Total	3,122	2,924	[3] 3,357	[3] 3,128
Total sand and gravel [4]	3,154	2,950	3,413	3,171
All operations:				
Sand	6,959	7,388	6,747	7,531
Gravel	10,922	12,116	11,052	12,575
Total	17,881	19,504	17,799	20,106

W Withheld to avoid disclosing individual company confidential data.

[1] Includes sand for other uses and data indicated by symbol W.

[2] Includes railroad ballast.

[3] Includes fill and other gravel.

[4] Data may not add to totals shown because of independent rounding.

position as the leading producer for the third straight year with 4.4 million tons or almost 25 percent of the State's total output. Six other counties each produced over 1 million tons—Berkshire, Bristol, Essex, Hampden, Norfolk, and Worcester.

Building and paving markets used over 82 percent of the sand and gravel produced in the State. Small quantities were used for fill and some sand was produced for molding, blast, filtration, and other uses. Commercial sand and gravel was produced in all counties in the State except Suffolk.

Stone.—Increases of 12 percent in output and 10 percent in value were reported by the stone industry in 1968. Forty-five percent, or $19.5 million of the State's total mineral value came from stone, which was second highest among mineral products. Stone was quarried in all counties except Barnstable, Dukes, and Nantucket. Middlesex County again led the State in both quantity and value of stone produced, with Norfolk County taking over second place.

Stone quarried in the State included basalt, granite, limestone, dolomite, sandstone, and miscellaneous stone. Crushed and broken stone made up almost 98 percent of the total stone output in 1968, with the remainder being dimension stone. The most important use of crushed stone was as concrete aggregate and roadstone, accounting for 81 percent of the total output. Production of basalt, the most important stone in both quantity and value, increased slightly over that in 1967. Granite, sandstone, and miscellaneous stone output also increased while limestone production decreased.

Basalt, produced by 13 companies at 15 quarries in seven counties, was sold as crushed stone. The stone was used mainly for concrete aggregate and roadstone, with minor quantities used for riprap, railroad ballast, and mineral stabilizer. Value of basalt accounted for 39 percent of the total stone value. Middlesex County led in production and value. Basalt was quarried in Franklin and Hampden Counties by the Commonwealth of Massachusetts, Department of Public Works, for use as concrete aggregate and roadmetal.

Table 6.—Stone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967		1968	
	Quantity	Value	Quantity	Value
Dimension stone	W	W	161	$4,826
Crushed and broken stone:				
Riprap	65	$77	W	W
Aggregate [1]	4,905	8,961	5,617	10,413
Agricultural limestone	147	542	144	498
Undistributed [2]	1,086	8,145	995	3,765
Total [3]	6,203	17,724	6,917	19,501

W Withheld to avoid disclosing individual company confidential data.

[1] Includes dense graded road base stone, and concrete, bituminous, macadam, and surface treatment aggregates.

[2] Includes crushed and broken stone for railroad ballast, furnace flux, and other uses, and data indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Granite was mined by 11 companies from 12 quarries in five counties. Middlesex County again led in value of granite produced, followed by Norfolk, Suffolk, Essex, and Plymouth Counties. Granite was second to basalt as the most important stone produced in the State. Sixty-nine percent of the value of granite production came from dimension granite used chiefly for curbing and flagging. Other uses were for rough and dressed architectural and construction purposes, monumental stone, paving blocks, and rubble. Concrete aggregate and roadstone were the chief uses for crushed granite, with smaller quantities used for riprap and other uses. The Department of Public Works quarried granite in Plymouth County for use mainly as riprap.

Limestone was mined in Berkshire County by four companies. One company also produced a small quantity of dolomite. Crushed limestone was used chiefly for lime manufacture, agriculture, concrete aggregate, roadstone, and for other purposes.

Sandstone was produced only in Hampden County as dimension stone for construction.

Miscellaneous stone, quarried in Bristol, Norfolk, and Worcester Counties, accounted for 9 percent of the total value of stone produced. The stone was used mainly for concrete aggregate and roadstone.

Roofing Granules.—Production of roofing granules, prepared from rhyolite quarried in Norfolk County, dropped more than

55 percent from output in 1967. For statistical purposes the rhyolite was classified as miscellaneous stone.

Vermiculite.—Sales of vermiculite decreased about 7 percent in value from those of 1967. One plant in Hampshire County exfoliated vermiculite mined outside the State. The material was used in agriculture, as insulation, and as lightweight aggregate for concrete and plaster.

MINERAL FUELS

Peat.—Production of peat declined by 20 percent in 1968. Sales increased by almost 48 percent. One company, Andover Sand and Gravel, Inc., which recovered humus peat from a bog in Essex County shut down permanently at the end of 1968. The company did not produce peat during the year but sales were made from inventories. Reedsedge peat was recovered from a Worcester County bog for use in packing flowers, plants, and shrubs.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
The Kelsey Ferguson Brick Co	Middleboro, Mass. 02346	Pit	Plymouth.
Masslite, Division of Blackstone Industries, Inc	Cross St., Box 1747 Plainville, Mass. 62027	Pit	Norfolk.
The Stiles & Hart Brick Co	Box J., Bridgewater, Mass. 02324	Pit	Plymouth.
Westfield Clay Products Co	Westfield, Mass. 01085	Pit	Hampden.
Gypsum, calcined: United States Gypsum Co	101 S. Wacker Dr., Chicago, Ill. 60606	Plant	Suffolk.
Lime:			
Lee Lime Corp	Marble St., Lee, Mass. 01238	do	Berkshire.
Minerals, Pigments & Metals Division, Chas. Pfizer & Co., Inc	260 Columbia St., Adams, Mass. 01220	do	Do.
United States Gypsum Co	101 S. Wacker Dr., Chicago, Ill. 60606	do	Do.
Peat:			
Andover Sand & Gravel, Inc	84 Beacon St., Lawrence, Mass. 02108	Bog	Essex.
Sterling Peat Co	Sterling Junction, Mass. 01565	Bog	Worcester.
Perlite, expanded:			
United States Gypsum Co	101 S. Wacker Dr., Chicago, Ill. 60606	Plant	Suffolk.
Whittemore Products, Inc	35 Harrison St., Roslindale, Mass. 02131	do	Do.
Roofing granules: Bird & Son, Inc	East Walpole, Mass. 02032	do	Norfolk.
Sand and gravel:			
Assabet Sand & Gravel Co., Inc	P.O. Box 246, Acton, Mass. 01720	Pit	Middlesex.
Assonet Sand & Gravel Co., Inc	South Main St., Assonet, Mass. 02702	Pit	Bristol.
Burlington Sand & Gravel Co., Inc	Blanchard Rd., Box 116 Burlington, Mass. 01803	Pit	Middlesex.
J.J. Cronin Co	P.O. Box 176, N. Reading, Mass. 01864	Pit	Do.
E. L. Dauphinais, Inc	160 Worcester Rd., N. Grafton, Mass. 01536	Pit	Worcester.
General Sand & Stone Corp	444 Merrill Rd., Pittsfield, Mass. 01201	Pit	Berkshire.
P.J. Keating Co	P.O. Box 345, Fitchburg, Mass. 01420	Pit	Worcester.
Lexington Sand & Gravel Co	Lawsbrook Rd., South Acton, Mass. 01720	Pit	Middlesex.
Merrimack Materials, Inc	Yemma Rd., Groveland, Mass. 01830	Pit	Essex.
Morse Sand & Gravel Co	P.O. Box 175, Pawtucket, R.I. 02863	Pit	Bristol.
North Wilbraham Sand & Gravel & Concrete Co., Inc	2420 Boston Rd., N. Wilbraham, Mass. 01095	Pit	Hampden.
Northfield Washed Sand & Gravel Co., Inc	Northfield, Mass. 01360	Pit	Franklin.
Pomerleau Bros. Inc	P.O. Box 236 N. Chelmsford, Mass. 01863	Pit	Middlesex.
L. Romano Const. Co	835 Taunton Ave., East Providence, R.I. 02919	Pit	Norfolk.
Rosenfeld Washed Sand & Stone Co	40 Cedar St., Milford, Mass. 02118	Pit	Worcester.
San-Vel Contracting Co	Route No. 2, Ayer Rd., Littleton, Mass. 01460	Pit	Middlesex.
Stow Sand & Gravel Co	P.O. Box 861, Acton, Mass. 01720	Pit	Do.
A.A. Will Sand & Gravel Corp	Turnpike, St., Canton Mass. 02021	Pit	Norfolk.
Worcester Sand & Gravel Co	182 Holden St., Shrewsbury, Mass. 01545	Pit	Worcester.
Stone:			
Basalt, crushed:			
B. & M. Crushed Stone Division Bayer & Mingolla Industries, Inc	Spring St., Ashland, Mass. 01721	Quarry	Middlesex.
George Brox, Inc	1471 Methuen St., Dracut, Mass. 01826	do	Do.
Essex Bituminous Concrete Corp	Russell St., West Peabody, Mass. 01960	do	Essex.
Essex Bituminous Concrete Corp. of Dracut	2140 Bridge St. Dracut, Mass. 01826	do	Middlesex.
Holden Trap Rock Co	N. Main St., Holden, Mass. 01520	do	Worcester.
P.J. Keating Co	P.O. Box 345 Fitchburg, Mass. 01420	do	Do.

See footnotes at end of table.

Table 7.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Basalt, crushed			
John S. Lane & Son, Inc	P.O. Box 125 Westfield, Mass. 01085	Quarry	Hampden and Hampshire.
Lynn Sand & Stone Co	30 Danvers Rd., Swampscott, Mass. 01907	do	Essex.
Massachusetts Broken Stone Co	Boston Post Road, Weston, Mass. 02193	do	Middlesex.
Mario Pandolf Co., Inc	106 Sachem Rd., Needham Heights, Mass. 02192	do	Worcester.
Rowe Contracting Co	1500 Salem St., Malden, Mass. 02148	do	Middlesex.
Simeone Stone Corp	P.O. Box 218, Wrentham, Mass. 02093	do	Norfolk.
Trimount Bituminous Products Co	1840 Parkway St. Everett, Mass. 02149	do	Essex.
Warner Bros., Inc	Sunderland, Mass. 01375	do	Franklin.
Granite, dimension:			
Bates Bros. Seam Face Granite Co. [1]	1372 Hancock St., Quincy, Mass. 01404	do	Norfolk.
H.E. Fletcher Co	W. Chelmsford, Mass. 01824	do	Middlesex.
Forrest Road Granite Co. Inc.[1]	20 Adams St. N. Chelmsford, Mass. 01824	do	Do.
Guilmette Bros. Corp	57 Ledge Rd., N. Chelmsford, Mass. 01824	do	Do.
Le Masurier Granite Quarry, Inc. [1]	P.O.Box 71, Ledge Rd., N. Chelmsford, Mass. 01824	do	Do.
Oak Hill Granite Co., Inc	Middlesex St., Lowell, Mass. 01852	do	Do.
Plymouth Quarries, Inc	East Weymouth, Mass. 01402	do	Plymouth.
Rockport Quarries Co., Inc	210 Kingsley Ave., Providence, R.I. 02903	do [2]	Essex.
Granite, crushed:			
Old Colony Crushed Stone Co	P.O. Box 230, Quincy, Mass. 01401	do	Norfolk.
Simeone Stone Corp	P.O. Box 218, Wrentham, Mass. 02093	do	Do.
West Roxbury Crushed Stone Co	10 Grove St., West Roxbury, Mass. 02132	do	Suffolk.
Limestone, crushed:			
John S. Lane & Son, Inc	P.O. Box 125, Westfield, Mass. 01085	do	Berkshire.
Lee Lime Corp	Marble St., Lee, Mass. 01238	do [3]	Do.
Minerals, Pigments & Metals Division, Chas. Pfizer & Co., Inc	260 Columbia St., Adams, Mass. 01220	do	Do.
United States Gypsum Co	101 S. Wacker Dr., Chicago, Ill. 60606	do	Do.
Miscellaneous stone, crushed:			
Berlin Stone Co	Sawyer Hill Rd., Berlin, Mass. 01503	Quarry	Worcester.
S. M. Lorusso & Sons, Inc	331 West St., Walpole, Mass. 02081	do	Norfolk.
Warren Bros. Co., Division of Ashland Oil & Refining Co	430 Howard St., Brockton, Mass. 02402	do	Bristol.
Sandstone, dimension: McCormick Longmeadow Stone Co., Inc	East Longmeadow, Mass. 01028	do [2]	Hampden.
Vermiculite, exfoliated: Zonolite Division, W. R. Grace & Co	62 Whittemore Ave., Cambridge, Mass. 02140	Plant	Hampshire.

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[1] Also crushed granite.
[2] 2 quarries.
[3] 2 quarries: 1 dolomite, 1 limestone.

The Mineral Industry of Michigan

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey Division of the Michigan Department of Natural Resources, for collecting information on all minerals except fuels.

By Donald F. Klyce [1]

In 1968 the value of mineral production in Michigan totaled $627.1 million, nearly 3 percent larger than the 1967 record high.

Most minerals had increased production over the previous year, with the exception of iron ore, lime, magnesium compounds, and petroleum.

The demand for construction materials continued to grow and value of output exceeded that of 1967 by about 5 percent. Chemicals recovered from natural salines increased about 1 percent over the previous year's production. These two nonmetallic mineral groups accounted for 57 percent of the value of State mineral production. Metallic minerals (34 percent) and mineral fuels (9 percent) accounted for the remaining value.

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[1] Industry economist, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Michigan[1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Cement:				
Portland ... thousand 376-pound barrels	29,645	$94,515	31,375	$99,158
Masonry ... thousand 280-pound barrels	1,995	5,296	2,006	5,527
Clays ... thousand short tons	2,466	2,636	2,599	2,906
Copper (recoverable content of ores, etc.) ... short tons	58,458	44,692	74,805	62,607
Gypsum ... thousand short tons	1,422	5,085	1,405	5,196
Iron ore (usable) ... thousand long tons, gross weight	14,130	162,610	12,699	148,890
Lime ... thousand short tons	1,787	21,582	1,630	19,870
Magnesium compounds ... short tons	309,446	26,388	266,406	25,087
Natural gas ... million cubic feet	33,589	8,296	40,480	10,160
Natural gas liquids:				
Natural gasoline ... thousand 42-gallon barrels[2]	1,139	3,491	1,066	3,177
LP gases ... do	1,414	3,444	1,384	3,432
Peat ... short tons	237,107	2,292	237,513	2,919
Petroleum (crude) ... thousand 42-gallon barrels	13,664	39,455	12,974	38,287
Salt ... thousand short tons	4,789	42,389	4,893	44,481
Sand and gravel ... do	52,310	49,616	56,663	54,979
Silver (recoverable content of ores, etc.) thousand troy ounces	302	468	473	1,014
Stone ... thousand short tons	36,432	39,910	37,279	41,092
Value of items that cannot be disclosed: Bromine, calcium chloride, calcium-magnesium chloride, gem stones, iodine, and potassium salts	XX	58,039	XX	58,293
Total	XX	610,204	XX	627,075
Total 1957-59 constant dollars	XX	552,334	XX	p 557,639

p Preliminary. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Previously reported in thousand gallons.

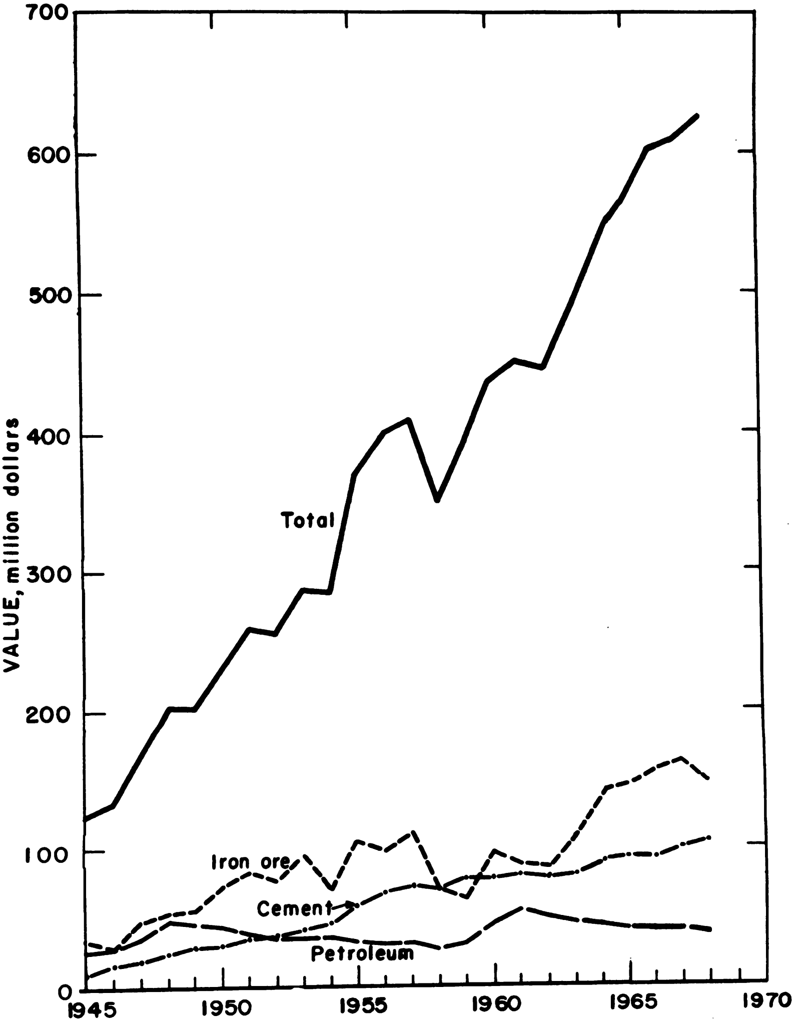

Figure 1.—Value of iron ore, petroleum, cement, and total value of all minerals produced in Michigan.

Table 2.—Value of mineral production in Michigan, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Alcona	$133	$117	Sand and gravel.
Alger	57	39	Do.
Allegan	992	[2] 1,020	Petroleum, sand and gravel, stone, peat, natural gas.
Alpena	W	W	Cement, stone, clays, sand and gravel.
Antrim	272	431	Clays, sand and gravel.
Arenac	1,081	1,032	Petroleum, stone, sand and gravel.
Baraga	72	105	Sand and gravel.
Barry	700	572	Sand and gravel, petroleum, stone.
Bay	9,637	10,230	Cement, sand and gravel, petroleum, lime.
Benzie	-------	4	Sand and gravel.
Berrien	2,554	2,450	Sand and gravel, stone.
Branch	585	W	Do.
Calhoun	7,191	[2] 7,092	Petroleum, sand and gravel, stone, natural gas.
Cass	311	224	Sand and gravel, stone, petroleum.
Charlevoix	906	8,928	Cement, stone, sand and gravel.
Cheboygan	69	123	Stone, sand and gravel.
Chippewa	W	W	Do.
Clare	1,795	W	Petroleum, sand and gravel, natural gas.
Clinton	315	539	Sand and gravel, clays.
Crawford	522	[2] 1,049	Petroleum, sand and gravel, natural gas.
Delta	260	165	Sand and gravel, stone.
Dickinson	19,749	23,819	Iron ore, sand and gravel, stone.
Eaton	603	652	Stone, sand and gravel, clays, peat.
Emmet	6,645	8,956	Cement, stone, sand and gravel.
Genesee	702	542	Sand and gravel, petroleum.
Gladwin	1,027	990	Petroleum, sand and gravel.
Gogebic	2,121	197	Sand and gravel.
Grand Traverse	W	274	Do.
Gratiot	W	W	Salines, salt, sand and gravel, petroleum, natural gas.
Hillsdale	12,161	[2] 10,801	Petroleum, sand and gravel, stone, natural gas.
Houghton	6,493	3,015	Copper, sand and gravel, stone.
Huron	897	886	Stone, sand and gravel, lime, petroleum.
Ingham	1,318	1,177	Sand and gravel, peat.
Ionia	W	260	Sand and gravel, petroleum.
Iosco	4,401	4,836	Gypsum, sand and gravel.
Iron	14,998	11,344	Iron ore, sand and gravel.
Isabella	1,336	[2] 1,083	Petroleum, sand and gravel, natural gas.
Jackson	4,966	[2] 4,449	Petroleum, sand and gravel, stone, natural gas.
Kalamazoo	1,239	1,358	Sand and gravel, stone, peat.
Kalkaska	112	221	Petroleum, sand and gravel.
Kent	3,474	[2] 4,580	Sand and gravel, gypsum, petroleum, peat, natural gas.
Keweenaw	W	1,989	Copper, sand and gravel.
Lake	44	W	Petroleum, sand and gravel.
Lapeer	1,489	[2] 2,112	Peat, petroleum, sand and gravel, salines, natural gas.
Leelanau	56	92	Sand and gravel.
Lenawee	510	[2] 940	Sand and gravel, clays, petroleum, natural gas.
Livingston	2,804	[2] 3,819	Sand and gravel, petroleum, natural gas.
Luce	38	112	Sand and gravel.
Mackinac	W	W	Stone, sand and gravel.
Macomb	2,011	[2] 2,452	Sand and gravel, petroleum, natural gas.
Manistee	22,105	20,795	Salt, salines, sand and gravel.
Marquette	127,026	114,494	Iron ore, sand and gravel.
Mason	W	W	Salines, lime, sand and gravel, petroleum.
Mecosta	980	[2] 1,024	Petroleum, sand and gravel, peat, natural gas.
Menominee	633	705	Lime, sand and gravel.
Midland	W	W	Salines, salt, petroleum, sand and gravel.
Missaukee	1,302	[2] 1,476	Petroleum, sand and gravel, natural gas.
Monroe	W	W	Cement, stone, clays, peat, petroleum.
Montcalm	714	W	Petroleum, sand and gravel, natural gas.
Montmorency	-------	53	Sand and gravel.
Muskegon	2,244	2,334	Salt, sand and gravel, petroleum.
Newaygo	173	419	Sand and gravel, petroleum.
Oakland	9,939	10,458	Sand and gravel, peat, petroleum.
Oceana	425	380	Sand and gravel, petroleum.
Ogemaw	1,941	[2] 1,756	Sand and gravel, petroleum, natural gas.
Ontonagon	36,099	59,041	Copper, silver, sand and gravel.
Osceola	1,611	[2] 1,896	Petroleum, sand and gravel, natural gas.
Oscoda	76	51	Sand and gravel, petroleum.
Otsego	42	W	Sand and gravel, natural gas.
Ottawa	2,586	[2] 2,412	Sand and gravel, petroleum, stone, natural gas.
Presque Isle	W	W	Stone, sand and gravel.
Roscommon	616	W	Petroleum, sand and gravel, natural gas.
Saginaw	434	635	Sand and gravel, clays, lime, petroleum.
St. Clair	14,679	[2] 16,143	Salt, cement, petroleum, clays, peat, sand and gravel, natural gas.
St. Joseph	279	W	Sand and gravel, peat, stone.
Sanilac	1,146	1,095	Peat, sand and gravel, lime.

See footnotes at end of table.

Table 2.—Value of mineral production in Michigan, by counties[1]—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Schoolcraft	W	W	Stone, sand and gravel.
Shiawassee	$632	$769	Sand and gravel, peat, clays, petroleum.
Tuscola	1,996	2,690	Sand and gravel, petroleum, lime, peat.
Van Buren	375	349	Sand and gravel, petroleum.
Washtenaw	1,974	[2] 2,353	Sand and gravel, petroleum, natural gas.
Wayne	55,288	[2] 54,472	Cement, lime, salt, sand and gravel, salines, stone, clays, petroleum, natural gas.
Wexford	84	[2] 122	Sand and gravel, natural gas.
Undistributed [3]	208,162	206,081	
Total [4]	610,204	627,075	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Values for natural gas and natural gas liquids are not available on a county basis, but are included with "Undistributed."

[2] Excludes value of natural gas.

[3] Includes values for natural gas, natural gas liquids, gem stones, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Michigan business activity

	1967	1968	Change (percent)
Employment and labor force, annual average:[1]			
Total labor force thousands	3,382.5	3,420.9	+1.1
Agricultural employment do	67.5	63.8	—5.5
Nonagricultural employment [2] do	3,141.3	3,179.8	+1.2
Manufacturing do	1,104.6	1,121.9	+1.6
Motor vehicles and equipment do	352.7	372.8	+5.7
Construction do	116.7	97.8	—16.2
Mining do	12.6	13.0	+3.2
Primary metal products do	93.0	94.2	+1.3
Stone, clay, and glass products do	18.9	17.4	—7.9
All other do	1,907.4	1,947.1	+2.1
Total manufacturing payrolls millions	[r] $9,564.2	$10,740.6	+12.3
Personal income:			
Total do	$29,151	[p] $32,105	+10.1
Per capita	$3,387	[p] $3,674	+8.5
Construction activity:			
Building permits:[3]			
Valuation of authorized residential construction millions	$859	$896	+4.4
Number of private and public residential units authorized	59,677	59,143	—.9
Contract construction work performed:			
Total millions	[r] $2,276	$2,350	+3.3
Nonresidential building do	$947	$913	—3.6
Residential building do	[r] $990	$1,030	+4.0
Nonbuilding do	$339	$408	+20.4
State highway department contracts awarded do	$112.3	$136.3	+21.4
Portland cement shipments to and within Michigan thousand 376-pound barrels	16,386	16,158	—1.4
Retail sales millions	$14,173	$15,542	+9.7
Farm marketing receipts do	[r] $855.3	[p] $866.8	+1.3
Mineral production do	$610.2	$627.1	+2.8
Raw steel production thousand tons	9,248	9,221	—.3
Utility production and consumption:			
Production of electric energy by electric utilities million kilowatt-hours	47,632.9	[p] 52,094.1	+9.4
Natural gas consumption million cubic feet	689,446	703,782	+2.1
International trade:[4]			
Value of exports through Michigan millions	$2,933.6	$3,484.9	+18.8
Value of imports through Michigan do	$2,556.5	$3,236.8	+26.6

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[p] Preliminary. [r] Revised.

[1] Adjusted to March 1968 benchmark levels.

[2] Includes nonagricultural wage and salary, self-employed, unpaid family workers, and domestic workers in private households.

[3] Based on a Nationwide survey of 13,000 permit issuing places.

[4] Includes Detroit Customs District.

Sources: Michigan Employment Security Division in cooperation with the United States Department of Labor, Survey of Current Business, Construction Reports, Statistical Abstract of the United States, State of Michigan Department of Highways, Sales Management, Farm Income Situation, American Iron & Steel Institute, Federal Power Commission, and U.S. Department of Commerce.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Peat	157	184	29	261	-------	2	7.67	31
Metal	5,549	282	1,565	12,503	11	481	39.35	6,806
Nonmetal	1,669	283	472	3,777	2	54	14.83	3,524
Sand and gravel	2,474	212	526	4,619	-------	93	20.14	705
Stone	3,391	295	1,000	8,025	-------	62	7.73	373
Total [1]	13,240	271	3,591	29,184	13	692	24.16	3,586
1968:p								
Peat	167	187	31	293	-------	-------	-------	-------
Metal	5,180	296	1,549	12,393	1	400	32.36	1,850
Nonmetal	1,790	274	491	3,924	-------	84	21.41	640
Sand and gravel	2,570	215	554	4,789	-------	104	21.72	963
Stone	3,410	288	983	7,918	-------	75	9.47	1,134
Total [1]	13,120	274	3,608	29,316	1	663	22.65	1,331

p Preliminary.

[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Portland cement shipments continued the upward trend which began in 1960, with a 6-percent increase over 1967 shipments. Masonry cement output showed a slight increase over that of the previous year. Portland cement was produced at nine plants in seven counties (Alpena, Bay, Charlevoix, Emmet, Monroe, St. Clair, and Wayne); masonry cement was produced at six of these plants. Annual finished portland cement capacity totaled more than 39 million barrels. Yearend stocks of portland cement at mills were 4 million barrels compared with 3.8 million barrels in 1967. More than 96 percent of the portland cement shipped was of types I and II (general use and moderate heat); the remainder was of type III (high-early-strength) and portland-pozzolan. About 46 percent of the portland cement was shipped to consumers within the State. Out-of-State distribution went mostly to Ohio, Wisconsin, Illinois, Indiana, Minnesota, and New York. About 62 percent of the shipments were purchased by ready-mixed concrete companies with the remainder going principally to concrete product manufacturers (16 percent), highway contractors (12 percent), and building material dealers (7 percent). About 1.8 million barrels of cement, mostly portland, were shipped into Michigan. The bulk of the shipments originated in Ohio (82 percent), with Pennsylvania and Indiana contributing most of the remainder.

Table 5.—Finished portland cement produced, shipped, and in stock

(Thousand 376-pound barrels and thousand dollars)

Year	Active plants	Production	Shipped from mills		Stocks at mills Dec. 31
			Quantity	Value	
1964	9	26,802	26,745	$84,316	2,737
1965	8	27,018	27,565	86,996	2,110
1966	8	28,848	28,171	87,413	3,219
1967	9	29,862	29,645	94,515	r 3,813
1968	9	31,195	31,375	99,158	4,043

r Revised.

Raw materials used in portland cement manufacture included 7.8 million tons of limestone, nearly 2.4 million tons of clay or shale, as well as quantities of gypsum, sand, iron ore, slag, mill scale, air-entraining compounds, and grinding aids. More than three-quarter billion kilowatt-hours of electrical energy was used. The wet process was used at eight plants and the dry process at one.

Clays.—Miscellaneous clay and shale were mined in 10 counties from 14 pits. Total output was 5 percent larger than in 1967. Increases in production of material for manufacturing pottery and stoneware, heavy clay products, and cement offset decreases in output for lightweight aggregates. About seven-eighths of the State production was used in cement manufacture, and the remainder mostly for lightweight aggregates and heavy clay products (building brick, sewerpipe,and draintile). The largest production was reported from operations in Alpena, Antrim, Monroe, Saginaw, St. Clair, and Wayne Counties.

Gem Stones.—Hobbyists collected gem stones principally along Lake Superior beaches in the Upper Peninsula. Agates, thomsonite, and other semiprecious stones were found as well as specimens of native copper and hematite.

Gypsum.—Gypsum output and value were substantially the same as in 1967, although unit price of the crude material was slightly higher. Crude gypsum was produced in Kent County from underground mines and processed at plants in Grand Rapids for plaster, lath, and wallboard. In Iosco County, gypsum was quarried at Whittemore for portland cement retarder. Quarries at Tawas City and Alabaster supplied crude gypsums for building material plants at National City, Detroit, and in Ohio and Wisconsin. Gypsum materials were shipped by lake transport from deepwater ports at National City and Alabaster.

Lime.—Decreased demand for lime by major users in manufacturing steel and chemicals was responsible for a decline in output of nearly 9 percent. Smaller quantities of lime were used in sugar refining, paper manufacture, water purification, and sewage treatment. Lime plants were operated in eight counties, but 81 percent of the production came from Wayne County to meet requirements of steel mills and chemical plants in the Detroit area. About 52 percent of the output was used by producers and the remainder sold. About 9 percent was shipped to consumers outside the State, mostly in Ohio and Wisconsin. About 267,000 tons of lime (four-fifths of it quicklime) were shipped into Michigan, with three-quarters of it coming from Ohio. Allied Chemical Corp. closed its Detroit lime plant in June and transferred the equipment to other operations. Data for lime regenerated at papermills and water purification plants are excluded from total State production.

Natural Salines.—Bromine, calcium chloride, calcium-magnesium chloride, iodine, magnesium compounds, and potash were extracted from natural well brines at chemical plants in Gratiot, Lapeer, Manistee, Mason, Midland, and Wayne Counties. Value of output was slightly below the 1967 level. The Manistee plant of Standard Lime & Refractories Co. is being modernized and expanded to include a new periclase plant, pollution control equipment, and facilities for producing high-purity magnesia.

Perlite.—Crude perlite, mined in Western States, was expanded at plants in Iosco, Kent, and Wayne Counties. The material was used for building plaster.

Salt.—Salt was recovered from natural and artificial brines at plants in Gratiot, Manistee, Midland, Muskegon, St. Clair, and Wayne Counties and produced from an underground mine in Detroit. Production was 2 percent greater than in 1967, with much of the increase resulting from an increased demand for salt for road use. Michigan salt was distributed throughout the country with the largest shipments going to Wisconsin, Illinois, Indiana, Ohio, and Minnesota.

Sand and Gravel.—Michigan sand and gravel production increased 8 percent and was valued at nearly $55 million, a record high. Michigan continued to hold second place (after California) in sand and gravel output. Sand and gravel for paving use increased 7 percent, for building use and fill 6 percent, and for industrial uses (molding, glass, engine, blast, abrasives, etc.) more than 24 percent. All counties except Monroe reported sand and gravel production. In 14 counties output exceeded 1 million tons and 38 percent of the State total was produced in the five-county Detroit Metropolitan Area. About 93 percent of the total sand and gravel output was processed. Over 91 percent of the total commercial production was transported by truck, 6 percent by rail, and 3 percent by water. Production was reported from 401 commercial and 136 Government-and-contractor operations.

Stone.—Stone was quarried in 27 counties. Nearly all of the State stone output was limestone and dolomite, principally from large quarries in Alpena, Chippewa, Mackinac, Monroe, and Presque Isle Counties. Three-quarters of the material was moved by water from company-operated ports on Lakes Huron and Michigan to cement and lime plants, steel mills, and other consumers. Demand for limestone and dolomite increased moderately (2 percent) with larger requirements reported for aggregate and roadstone, cement, flux stone, and lime. Lesser shipments for agricultural and chemical uses were reported. Beginning with 1968, a more detailed breakdown of aggregate and roadstone is presented in table 9.

Small amounts of dimension limestone and sandstone were produced for building purposes. Dimension limestone was quarried and processed in Eaton, Huron, and Presque Isle Counties.

Table 6.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	6,508	$5,990	7,475	$6,481
Paving	5,565	4,550	6,704	5,585
Fill	3,401	1,601	3,956	1,743
Molding	3,231	6,198	4,129	7,637
Other [1]	810	2,111	914	2,177
Total	19,515	20,450	23,178	23,623
Gravel:				
Building	6,585	9,198	6,425	9,727
Paving	16,604	14,514	18,666	16,915
Fill	419	300	393	293
Other [2]	120	184	188	304
Total	23,728	24,196	25,672	27,239
Total sand and gravel	43,243	44,646	48,850	50,862
Government-and-contractor operations:				
Sand:				
Building	90	49	--------	--------
Paving	2,291	1,121	1,839	845
Fill	919	373	747	310
Other	102	44	151	58
Total	3,402	1,587	2,737	1,213
Gravel:				
Building	--------	--------	21	11
Paving	5,301	3,225	4,753	2,759
Fill	364	158	301	134
Other	--------	--------	1	([3])
Total	5,665	3,383	5,076	2,904
Total sand and gravel	9,067	4,970	7,813	[4] 4,111
All operations:				
Sand	22,917	22,037	25,915	24,836
Gravel	29,393	27,579	30,748	30,143
Total	52,310	49,616	56,663	54,979

[1] Includes foundry (1967), chemical and railroad ballast (1968), abrasives, blast, enamel, engine, glass, pottery, porcelain, tile, and other construction and industrial uses.
[2] Includes railroad ballast and other construction uses.
[3] Less than ½ unit.
[4] Data may not add to total shown because of independent rounding.

Table 7.—Production of sand and gravel by counties

(Thousand short tons and thousand dollars)

County	1967		1968		County	1967		1968	
	Quantity	Value	Quantity	Value		Quantity	Value	Quantity	Value
Alcona	274	$133	230	$117	Leelanau	105	$56	148	$92
Alger	93	57	63	39	Lenawee	579	478	1,122	915
Allegan	401	278	751	462	Livingston	2,810	2,802	3,593	3,816
Alpena	187	W	135	120	Luce	35	38	221	112
Antrim	92	W	92	W	Mackinac	W	W	205	98
Arenac	W	W	49	39	Macomb	2,524	2,004	2,838	2,423
Baraga	152	72	214	105	Manistee	W	W	W	W
Barry	639	663	537	531	Marquette	877	741	363	W
Bay	------	------	W	W	Mason	975	W	W	W
Benzie	------	------	12	4	Mecosta	186	W	324	W
Berrien	2,595	2,550	1,982	2,445	Menominee	417	W	407	W
Branch	589	W	455	W	Midland	W	242	327	W
Calhoun	978	485	760	W	Missaukee	17	11	5	3
Cass	326	285	245	208	Monroe	------	------	------	------
Charlevoix	190	W	114	W	Montcalm	411	215	328	W
Cheboygan	17	21	86	W	Montmorency	------	------	81	53
Chippewa	W	W	285	209	Muskegon	477	W	487	W
Clare	203	W	186	W	Newaygo	184	113	701	354
Clinton	354	W	601	W	Oakland	9,707	9,889	10,365	10,395
Crawford	88	53	30	19	Oceana	329	210	320	210
Delta	334	W	264	W	Ogemaw	1,288	1,080	1,099	937
Dickinson	293	218	143	W	Ontonagon	230	W	234	144
Eaton	416	W	402	313	Osceola	218	143	221	176
Emmet	364	W	81	W	Oscoda	136	71	91	46
Genesee	397	696	572	517	Otsego	66	42	11	W
Gladwin	24	10	29	17	Ottawa	2,462	2,275	2,479	2,184
Gogebic	151	W	276	197	Presque Isle	521	W	565	W
Grand Traverse	172	W	548	274	Roscommon	212	127	W	W
Gratiot	279	W	326	297	Saginaw	W	W	W	W
Hillsdale	399	476	W	W	St. Clair	W	W	141	75
Houghton	W	W	269	223	St. Joseph	336	269	538	W
Huron	133	101	157	126	Sanilac	395	W	342	W
Ingham	1,872	1,816	1,878	1,175	Schoolcraft	151	W	29	19
Ionia	435	W	425	260	Shiawassee	745	512	699	W
Iosco	77	31	672	W	Tuscola	1,475	1,714	2,350	W
Iron	94	W	226	W	Van Buren	414	345	416	318
Isabella	665	612	502	401	Washtenaw	1,912	1,903	1,942	2,306
Jackson	306	268	318	308	Wayne	2,511	4,349	2,686	4,477
Kalamazoo	1,120	1,182	1,110	1,304	Wexford	97	84	158	122
Kalkaska	W	W	17	9	Undistributed [1]	2,210	7,694	3,008	12,296
Kent	2,224	2,483	2,918	3,496					
Keweenaw	66	34	40	18	Total	52,310	49,616	56,663	54,979
Lake	34	30	W	W					
Lapeer	265	155	324	180					

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes production for which no county breakdown is available, and data indicated by symbol W.

Table 8.—Dimension stone sold or used by producers, by kinds

Year	Basalt		Limestone		Sandstone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1964	150	$150	5,383	$68,711	8,306	$62,030	13,839	$130,891
1965	-------	---------	5,286	76,989	6,396	42,760	11,682	119,749
1966	-------	---------	4,266	64,166	8,109	53,510	12,375	117,676
1967	-------	---------	3,241	61,150	2,770	16,690	6,011	77,840
1968	-------	---------	2,680	51,271	1,500	15,000	4,180	66,271

Table 9.—Crushed and broken stone sold or used by producers, by kinds and uses

(Thousand short tons and thousand dollars)

Kind and use	1967		1968	
	Quantity	Value	Quantity	Value
Basalt: Surface treatment aggregates	[1] 27	[1] $35	21	$33
Granite: Exposed aggregate	3	62	2	60
Limestone and dolomite:				
Concrete aggregate and roadstone:				
Concrete aggregate	NA	NA	3,490	4,035
Bituminous aggregate	NA	NA	1,023	1,352
Macadam aggregates	NA	NA	214	307
Dense graded road base stone	NA	NA	936	1,151
Surface treatment aggregates	NA	NA	334	485
Total aggregate and roadstone [2]	5,952	7,313	5,997	7,329
Agricultural limestone	757	1,093	689	872
Cement	9,080	7,570	9,370	7,954
Flux	11,270	13,638	11,376	14,327
Lime	6,224	6,615	6,792	7,102
Railroad ballast	308	380	281	370
Other [3]	2,673	3,025	2,612	2,873
Total [2]	36,265	39,633	37,116	40,827
Marl: Agricultural purposes	132	103	134	106
Grand total [2]	36,426	39,832	37,275	41,026

NA Not available.

[1] Considered "Concrete aggregate and roadstone" for 1967.

[2] Data may not add to totals shown because of independent rounding.

[3] Includes stone used for dead-burned dolomite (1968); asphalt filler and other fillers or extenders; chemical uses; mine dusting; poultry grit and mineral food; railroad ballast; riprap and jetty stone; stone sand; terrazzo and exposed aggregate; and other uses.

Sandstone was produced in Jackson County and used as rubble. Granite was quarried and crushed in Dickinson County for use as facing aggregate in architectural concrete. In Houghton County, basalt was quarried and crushed for road use. Marl was produced in 11 counties and sold for agricultural use.

United States Steel Corp. announced a rehabilitation and modernization program for its Calcite plant in Rogers City. The plan includes installation of new tunnels for reclaiming stone from new or expanded storage piles, new conveyor belt lines to supplement or replace existing ones, traveling stackers to stock limestone, a new primary as well as a new final screening station, a new tertiary stone crusher, and a complex of screens to size and rescreen crushed limestone. The modernization will enable the plant to produce larger quantities of small stone sizes for steelmaking and allow for closer tolerances on stone sizes shipped to customers in the chemical and cement industries.

Bethlehem Steel Corp. acquired the Drummond Dolomite, Inc., dolomite quarry, on Drummond Island in Lake Huron. Bethlehem Steel Corp. was also reported to have acquired large acreage in the Point Patterson area of Mackinac and Schoolcraft Counties for development of limestone deposits for its steel mill.

Sulfur.—Byproduct sulfur was recovered from crude petroleum at oil refineries in Alma, Detroit, and Trenton. Shipments were at about the same level as in 1967.

Vermiculite.—Crude vermiculite, mined in Southern and Western States, was exfoliated at a plant in Dearborn and used for loose fill insulation, building plaster aggregate, concrete aggregate, agricultural, and other uses.

METALS

Copper.—Production of copper, in terms of recoverable metal content, was 28 percent greater than in 1967, despite a labor strike that began at Calumet & Hecla Corp. operations on August 21 and continued through the remainder of 1968. The average weighted price for copper increased from 38.2 to 41.8 cents per pound.

The copper smelter operated by the Quincy Mining Co. resumed operations as a custom smelter of scrap copper after a changeover of the reverberatory furnace from coal to gas fuel.

The White Pine Mine No. 3 shaft was completed and equipped during the year. The 1,600-foot shaft is 5 miles from the present portal and will give access to ore reserves distant from present facilities. An 18-foot boring machine is engaged in connecting this shaft with the main workings.

The merger of Calumet & Hecla into Universal Oil Products Co. was completed on April 30. Underground diamond drilling on the company's Hills Creek deposit was suspended by the labor strike, although deep drilling from the surface continued. One hole was completed during 1968, and two additional holes were in progress at yearend.

Iron Ore.—Iron-ore shipments in 1968 were 10 percent lower than in 1967, although shipments of pellets continued to increase. Pellets comprised about 77 percent of the total shipments, compared with 73 percent in 1967. Average weighted mine value for Michigan usable iron ore in 1968 was $11.72 per ton compared with $11.51 in 1967.

About 84 percent of the crude ore mined came from open-pit mines, and the remainder from six underground mines. Average iron content of usable ore produced was 60.56 percent natural, compared with 60.25 percent in 1967.

Michigan iron ore was shipped to producers of pig iron and steel, except for a small quantity used in manufacturing iron oxide pigments. About 99 percent of the ore was shipped by rail to ore docks in Escanaba and Marquette and then by ship to lower Lake ports. The remainder was shipped by rail to consuming districts.

The lake shipping season for Michigan iron ore opened at Escanaba on March 31 and closed at the same port on December 19. Chicago & North Western Railway Co. announced plans to construct a large $16 million iron-ore transfer and storage terminal at Escanaba designed to unload trains and store pellets on a year-round basis and to load out iron ore pellets and natural iron ore during the shipping season. The terminal is scheduled for operation at the start of the 1969 shipping season.

Table 10.—Mine production of copper, in terms of recoverable metal

Year	Mines producing		Material treated		Copper	
	Lode	Tailing	Ore (thousand short tons)	Tailing (thousand short tons)	Short tons	Value (thousands)
1964	9	3	6,718	2,174	69,040	$45,014
1965	10	3	7,368	1,611	71,749	50,798
1966	10	3	8,000	1,851	73,449	53,133
1967	8	3	6,091	1,307	58,458	44,692
1968	4	--------	8,027	--------	74,805	62,607

Table 11.—Crude iron ore data, in 1968, by counties and ranges

(Thousand long tons)

County and range	Stocks Jan. 1	Production		Shipments		Stocks Dec. 31
		Underground	Open pit	Direct to consumers	To concentrators	
County:						
Dickinson	--------	--------	4,845	--------	4,845	--------
Iron	1,001	1,780	--------	1,599	--------	1,183
Marquette	r 554	2,863	19,729	754	21,805	587
Total [1]	r 1,554	4,644	24,574	2,353	26,650	1,770
Range:						
Marquette	r 554	2,863	19,729	754	21,805	587
Menominee	1,001	1,780	4,845	1,599	4,845	1,183
Total [1]	r 1,554	4,644	24,574	2,353	26,650	1,770

r Revised.

[1] Data may not add to totals shown because of independent rounding.

Table 12.—Usable iron ore[1] produced (direct-shipping and all forms of concentrate), by ranges

(Thousand long tons)

Year	Marquette range	Menominee range (Michigan part)	Gogebic range (Michigan part)	Total		
				Gross weight		Iron content (percent)
				Ore[2]	Iron content	
1854–1963	322,909	265,963	247,484	836,355	NA	NA
1964	7,898	4,551	1,227	13,676	7,923	57.93
1965	8,973	4,595	753	14,322	8,343	58.25
1966	9,589	4,620	113	14,322	8,432	58.87
1967	10,231	3,750	49	14,030	8,453	60.25
1968	10,086	3,684	---------	13,770	8,339	60.56
Total[2]	369,687	[3] 287,162	[3] 249,626	906,475	NA	NA

NA Not available.
[1] Exclusive, after 1905, of iron ore containing 5 percent or more manganese.
[2] Data may not add to totals shown because of independent rounding.
[3] Distribution by range partly estimated before 1906.

Table 13.—Iron ore[1] shipped from mines

(Thousand long tons)

Year	Direct-shipping ore[2]	Concentrates			Total usable ore[3]	Proportion of concentrates to total usable ore (percent)
		Agglomerates	Other	Total[3]		
1964	5,753	6,573	1,546	8,118	13,871	58.53
1965	4,969	7,554	1,004	8,558	13,527	63.26
1966	4,272	8,690	1,415	10,106	14,377	70.28
1967	3,011	10,336	783	11,119	14,130	78.69
1968	2,353	9,786	560	10,346	12,699	81.47

[1] Exclusive of iron ore containing 5 percent or more manganese.
[2] Includes crushed, screened, and sized ore not further treated.
[3] Data may not add to totals shown because of independent rounding.

The Institute of Mineral Research at Michigan Technological University announced plans for a feasibility investigation of commercial production from low-grade iron carbonate formations in Iron County. An estimated billion-ton reserve near Alpha contains twice as many units of iron as the entire Menominee range has produced from oxide ores since mining started. The deposit extends in a 5-mile belt having an average width of 1,000 feet, and is amenable to open-pit mining.

According to the Michigan Department of Natural Resources,[2] the average cost per ton for underground mines was $9.26 in 1968 compared with $9.02 in 1967. Labor costs increased to $2.59 per ton, while taxes (excluding Federal income tax) increased to $0.33 per ton. Deferred costs per ton were $0.49, and other costs were as follows: General overhead, $1.32; royalty, $0.40; and marketing, $0.055.

Pig Iron and Steel.—Pig iron and steel were manufactured in the Detroit area by the Ford Motor Co. at Dearborn; National Steel Corp. at Ecorse; and McLouth Steel Corp. at Trenton. Pig iron shipments and value were 2 percent smaller than in 1967. Basic, foundry, and low phosphorus grades were produced.

About 2.1 million tons of iron and manganiferous ores, mostly domestic, were consumed in agglomerating plants and blast and steel furnaces.

The American Iron & Steel Institute reported Michigan steel production of 9.2

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[2] Geological Survey Division, Michigan Department of Natural Resources. General Statistics Covering Cost and Production of Michigan Iron Mines. 1969, 5 pp.

million tons, about the same output as in 1967.

Silver.—Silver was recovered from copper ore mined and milled by the White Pine Copper Co. Concentrate from its silver-recovery circuit was smelted separately for delivery to electrolytic refineries where the silver was recovered. Silver contained in fire-refined copper was not recovered but was marketed as a constituent of Lake copper. Output in 1968 was 57 percent larger than in 1967, when a prolonged labor strike at the White Pine operation curtailed production. Because of the sharply increased price of silver, value of the 1968 production was more than double that of 1967.

MINERAL FUELS

Natural Gas and Natural Gas Products.—Natural gas was produced in 25 counties from both oil and gas wells. More than 90 percent of the production came from five counties, with St. Clair County supplying nearly half (48 percent) of the total State output.

Natural gas liquids were stripped from Michigan gas principally at the Albion-Scipio, Bell River Mills, Boyd, and Reed City gas plants. Additional natural gas liquids were stripped from gas delivered by interstate pipeline from out-of-State gasfields at a plant in Washtenaw County.

Peat.—Michigan again led the Nation in peat production with 38 percent of the total. Peat was produced in 14 counties, with 47 percent of the State output from Lapeer County; Oakland, St. Clair, Sanilac, and Shiawassee Counties accounted for much of the remainder. Peat was marketed principally as a soil conditioner, and nearly 78 percent of the output was sold in packaged form. None was sold for fuel. About 92 percent of the peat mined was reed-sedge, and the remainder was moss and humus.

Petroleum.—Petroleum was produced in 45 counties, with the largest output reported from Calhoun, Hillsdale, and Jackson Counties (fields in the Albion-Pulaski-Scipio trend). According to the Geological Survey Division, Michigan Department of Natural Resources, the most active regions of new field exploration and field development drilling were in Macomb and St. Clair Counties and the area along the Albion-Pulaski-Scipio oilfield trend. Activity also increased in the western part of the State. Statewide, the discovery-to-dry hole ratio for new field wildcat wells was 1:12 compared with 1:20 in 1967. About 36 percent of the exploratory wells bottomed out in Devonian age rocks, 20 percent in Ordovician age rocks, and 33 percent in Silurian age rocks. The remainder reached total depth in rocks younger than Devonian in age. One Precambrian or basement test was drilled during 1968 in Koehler Township of Presque Isle County. Thirteen new fields were discovered in 1968 and one new pool discovery was reported. Ten refineries had an operating capacity of 163,400 barrels per day.

Table 14.—Crude petroleum production, by counties

(Thousand 42-gallon barrels and thousand dollars)

County	1967		1968	
	Quantity[1]	Value[2]	Quantity[1]	Value[2]
Allegan	242	$700	185	$546
Arenac	273	789	251	740
Barry	11	32	12	35
Bay	322	929	309	911
Calhoun	2,314	6,682	2,246	6,628
Cass	3	9	1	3
Clare	587	1,695	561	1,657
Crawford	162	469	349	1,030
Genesee	2	6	8	25
Gladwin	352	1,017	330	973
Gratiot	24	68	17	51
Hillsdale	4,046	11,683	3,511	10,362
Huron	3	8	2	5
Ionia	------	------	(3)	(3)
Isabella	251	724	231	682
Jackson	1,603	4,628	1,387	4,094
Kalkaska	34	98	72	212
Kent	88	253	76	224
Lake	5	14	49	144
Lapeer	64	186	70	208
Lenawee	6	18	(3)	1
Livingston	1	2	1	3
Macomb	2	7	10	29
Mason	88	254	70	206
Mecosta	293	$847	275	$811
Midland	218	629	206	607
Missaukee	447	1,291	499	1,473
Monroe	6	17	4	11
Montcalm	173	499	144	425
Muskegon	71	204	67	197
Newaygo	21	60	22	65
Oakland	1	2	1	2
Oceana	74	215	58	170
Ogemaw	298	861	278	819
Osceola	509	1,468	583	1,720
Oscoda	2	5	2	5
Ottawa	107	310	77	227
Roscommon	169	489	163	480
Saginaw	23	65	23	68
St. Clair	642	1,852	710	2,094
Shiawassee	4	11	10	30
Tuscola	74	215	71	209
Van Buren	11	30	11	31
Washtenaw	25	71	16	47
Wayne	15	44	9	27
Total[4]	13,664	39,455	12,974	38,287

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[1] Source: Geological Survey Division, Michigan Department of Natural Resources. General Statistics Covering Cost and Production of Michigan Iron Mines. 1969, 5 pp.

[2] County values calculated by using State average value per barrel; $2.89 for 1967 and $2.95 for 1968.

[3] Less than ½ unit.

[4] Data may not add to totals shown because of independent rounding.

Table 15.—Oil and gas wells drilled in 1968

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage [1]
Alcona	-----	-----	-----	-----	-----	1	1	722
Allegan	-----	-----	2	-----	-----	2	4	6,439
Antrim	-----	-----	-----	-----	-----	2	2	10,262
Arenac	-----	-----	-----	-----	-----	1	1	3,220
Barry	-----	-----	-----	-----	-----	1	1	1,814
Bay	1	-----	-----	-----	-----	2	3	7,573
Calhoun	11	1	21	-----	-----	1	34	153,495
Clare	-----	-----	-----	1	-----	-----	1	4,048
Crawford	4	-----	-----	-----	-----	1	5	21,922
Eaton	-----	-----	-----	-----	-----	1	1	5,000
Genesee	4	-----	1	-----	-----	-----	5	9,208
Grand Traverse	-----	-----	-----	-----	-----	3	3	17,409
Gratiot	-----	-----	-----	-----	-----	3	3	7,648
Hillsdale	5	-----	8	-----	-----	9	22	90,320
Ionia	-----	-----	-----	-----	-----	2	2	8,744
Iosco	-----	-----	-----	-----	-----	1	1	3,265
Isabella	3	-----	3	-----	-----	5	11	42,891
Jackson	1	-----	7	-----	-----	4	12	50,426
Kalkaska	-----	-----	-----	-----	-----	1	1	6,950
Kent	-----	-----	2	-----	-----	1	3	11,305
Lake	10	-----	3	-----	-----	4	17	41,734
Lapeer	4	-----	-----	-----	-----	-----	4	11,698
Lenawee	-----	-----	1	-----	1	-----	2	1,355
Livingston	-----	-----	-----	1	-----	1	2	10,118
Macomb	1	3	6	-----	1	25	36	113,482
Manistee	-----	-----	-----	-----	-----	2	2	7,997
Mason	-----	-----	1	1	-----	12	14	29,214
Mecosta	1	-----	1	1	-----	2	5	17,710
Midland	-----	-----	-----	-----	-----	1	1	3,520
Missaukee	1	-----	4	-----	-----	-----	5	20,984
Montcalm	-----	-----	2	-----	-----	1	3	9,455
Muskegon	3	-----	4	-----	-----	1	8	15,271
Newaygo	-----	-----	2	2	-----	6	10	26,897
Oakland	-----	1	-----	-----	-----	-----	1	4,415
Oceana	-----	-----	1	-----	-----	4	5	10,669
Ogemaw	1	-----	1	-----	-----	-----	2	7,606
Osceola	3	-----	5	1	1	7	17	53,485
Ottawa	-----	-----	-----	-----	-----	3	3	5,702
Presque Isle	-----	-----	-----	-----	-----	3	3	12,599
Roscommon	-----	-----	-----	-----	-----	1	1	1,460
St. Clair	5	3	24	3	-----	36	71	208,191
Shiawassee	4	-----	-----	-----	-----	-----	4	6,590
Van Buren	-----	-----	1	-----	-----	3	4	5,970
Washtenaw	-----	-----	1	-----	-----	1	2	9,133
Total	62	8	101	10	3	154	338	1,097,916

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[1] Includes only wells drilled and completed for oil and gas.

Table 16.—Principal producers [1]

Commodity and company	Address	Type of activity	County
Cement:			
Aetna Portland Cement Co., Martin Marietta Corp.	Box 8 Bay City, Mich. 48706	Portland and masonry, wet process.	Bay.
Dundee Cement Co.	Box 317 Dundee, Mich. 48131	do	Monroe.
Huron Cement Co., Division of National Gypsum Co.	1325 Ford Bldg. 615 Griswold St. Detroit, Mich. 48226	Portland and masonry, dry process.	Alpena.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	Portland and masonry, wet process.	Charlevoix.
Peerless Cement Co., Division of American Cement Corp.:	900 Detroit Trade Center Detroit, Mich. 48226		
Port Huron Plant		Portland, wet process	St. Clair.
Brennan Ave. Plant		do	Wayne.
Jefferson Ave. Plant		Portland and masonry, wet process.	Do.
Penn-Dixie Cement Corp.	Box 152 Nazareth, Pa. 18064	do	Emmet.
Wyandotte Chemicals Corp.	1609 Biddle Ave. Wyandotte, Mich. 48192	do	Wayne.
Clays and shale:			
Aetna Portland Cement Co., Martin Marietta Corp.	Box 8 Bay City, Mich. 48706	Pit	Saginaw.
Dundee Cement Co.	Box 317 Dundee, Mich. 48131	do	Monroe.
Huron Cement Co., Division of National Gypsum Co.	1325 Ford Bldg. 615 Griswold St. Detroit, Mich. 48226	do	Alpena.
Light Weight Aggregate Corp.	12720 Farmington Road Livonia, Mich. 48150	Pit and plant	Wayne.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	Pit	Antrim.
Peerless Cement Co., Division American Cement Corp.	900 Detroit Trade Center Detroit, Mich. 48226	Pits	St. Clair, Wayne.
Penn-Dixie Cement Corp.	Box 152 Nazareth, Pa. 18064	Pit	Antrim.
Coke:			
Industrial Chemicals Division Allied Chemical Corp.	Box 70 Morristown, N.J. 07960	Coke ovens	Wayne.
Ford Motor Co.	The American Road Dearborn, Mich. 48121	do	Do.
National Steel Corp. (Great Lakes Steel Division).	2800 Grant Bldg. Pittsburgh, Pa. 15219	do	Do.
Copper:			
Calumet & Hecla Corp.:	Calumet Ave. Calumet, Mich. 49913		
Centennial No. 6 Mine		Mine	Houghton.
Osceola No. 13 Mine		do	Do.
Kingston Mine		do	Keweenaw.
Ahmeek Mill		Mill	Do.
White Pine Copper Co.: White Pine.	Box 427 White Pine, Mich. 49971	Mine and mill	Ontonagon.
Gypsum:			
Georgia-Pacific Corp., Gypsum Division.	Box 311 Portland, Oreg. 97207	Underground mine, and calcining and board plant.	Kent.
Grand Rapids Gypsum Co.	Box 1674 Grand Rapids, Mich. 49501	do	Do.
Michigan Gypsum Co.	2840 Bay Road Saginaw, Mich. 48601	Open-pit mine	Iosco.
National Gypsum Co.	325 Delaware Ave. Buffalo, N.Y. 14202	Open-pit mine, and calcining and board plant.	Do.
United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	Open-pit mine Calcining and board plant.	Do. Wayne.
Iron ore:			
Cleveland-Cliffs Iron Co.:	1460 Union Commerce Bldg. Cleveland, Ohio 44115		
Cliffs Shaft		Stockpile shipments	Marquette.

See footnote at end of table.

Table 16.—Principal producers[1]—Continued

Commodity and company	Address	Type of activity	County
Iron ore—Continued			
Cleveland-Cliffs Iron Co.—Continued	1460 Union Commerce Bldg. Cleveland, Ohio 44115		
Eagle Mills pellet plant		Pelletizes ore from the Republic mine.	Marquette.
Empire		Open-pit mine, concentrator and agglomerator.	Do.
Humboldt		do	Do.
Mather		Underground mine. Ore treated at the Ore Improvement Plant and Pioneer Pellet Plant.	Do.
Ore improvement plant		Processed Mather ore	Do.
Pioneer pellet plant		Pelletizes ore from the Mather mine.	Do.
Republic		Open-pit mine, concentrator, and agglomerator. Part of the concentrates pelletized at the Eagle Mills plant.	Do.
Tilden		Stockpile shipments	Do.
The Hanna Mining Co.:			
Groveland	100 Erieview Plaza Cleveland, Ohio 44114	Open-pit mine, concentrator, and agglomerator.	Dickinson.
Homer		Underground mine	Iron.
Wauseca		do	Do.
Inland Steel Co.:			
Bristol	30 West Monroe St. Chicago, Ill. 60603	do	Do.
Sherwood		do	Do.
Jones & Laughlin Steel Corp.: Tracy.	Michigan Ore Division Negaunee, Mich. 49866	do	Marquette.
Iron and steel:			
Ford Motor Co	The American Road Dearborn, Mich. 48121	Iron blast furnaces and open-hearth steel furnaces.	Wayne.
McLouth Steel Corp	300 South Livernois Ave. Detroit, Mich. 48217	do	Do.
National Steel Corp. (Great Lakes Steel Division).	2800 Grant Bldg. Pittsburgh, Pa. 15219	do	Do.
Lime:			
Detroit Lime Co	8800 Dix Ave. Detroit, Mich. 48209	Quicklime, shaft and rotary kilns.	Wayne.
The Dow Chemical Co	Midland, Mich. 48640	Quicklime, three rotary kilns, one continuous hydrator.	Mason.
Marblehead Lime Co	300 West Washington St. Chicago, Ill. 60606	Quicklime, two rotary kilns.	Wayne.
Wyandotte Chemicals Corp	1609 Biddle Ave. Wyandotte, Mich. 48192	Quicklime, nine shaft kilns.	Do.
Peat:			
Anderson Peat Co	2562 Graham Rd. Imlay City, Mich. 48444	Bog, processing plant	Lapeer.
Fletcher & Rickard	54001 Grand River Rd. New Hudson, Mich. 48165	do	Oakland.
J. M. Huber Corp	(Peat Department) Thornall St. Edison, N.J. 08817	Bogs, processing plants.	Lapeer, Sanilac.
Michigan Peat	1 Decker Sq.—Suite 325 Bala-Cynwyd, Pa. 19004	do	Lapeer, St. Clair, Sanilac.
Scenic Lakes, Inc	Box 566 East Lansing, Pa. 48823	Bog, processing plant	Shiawassee.
Petroleum refineries:			
Bay Refining Division, The Dow Chemical Co.	4868 Wilder Road Bay City, Mich. 48709		Bay.
Crystal Refining Co	901 North Williams Carson City, Mich. 48811		Montcalm.
Lakeside Refining Co	2705 East Cork Kalamazoo, Mich. 49001		Kalamazoo.
Leonard Refineries, Inc.:			
Alma Division	East Superior St. Alma, Mich. 48801		Gratiot.

See footnote at end of table.

Table 16.—Principal producers[1]—Continued

Commodity and company	Address	Type of activity	County
Petroleum refineries—Continued			
Leonard Refineries Inc.—Continued			
Roosevelt Oil & Refining Division.	Box 271 Pickard Ave. & A.A.R.R. Mt. Pleasant, Mich. 48858		Isabella.
Marathon Oil Co.	1800 South Fort St. Detroit, Mich. 48217		Wayne.
Naph-Sol Refining Co.	1222 M-20, Box 630 Muskegon, Mich. 49443		Muskegon.
Osceola Refining Co.	Box 178 Reed City, Mich. 49677		Ogemaw.
Petroleum Specialties, Inc.	Box 448 Trenton, Mich. 48183		Wayne.
Socony Mobil Oil Co., Inc.	Box 477 Trenton, Mich. 48183		Do.
Expanded perlite:			
Bestwall Gypsum Division Georgia-Pacific Corp.	Commonwealth Bldg. Portland, Oreg. 97207	Processing plant	Kent.
National Gypsum Co.	325 Delaware Ave. Buffalo, N.Y. 14202	do	Iosco.
United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	do	Wayne.
Salt and salines:			
American Salt Co.	3142 Broadway Kansas City, Mo. 64111	Processing plant: Salt	Midland.
Diamond Crystal Salt Co.	916 South Riverside St. Clair, Mich. 48079	Brine wells and processing plant: Salt.	St. Clair.
The Dow Chemical Co.:			
Ludington plant	Midland, Mich. 48640	Brine wells and processing plant: Bromine, calcium compounds, and magnesium compounds.	Mason.
Midland plant		Brine wells and processing plant: Bromine, calcium compounds, iodine, magnesium compounds, potash, and salt.	Midland.
Harbison-Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15222	Processing plant: Magnesium compounds.	Mason.
Hooker Chemical Corp.	Box 295 Montague, Mich. 49437	Processing plant: Salt	Muskegon.
International Salt Co., Inc.	Clarks Summit, Pa. 18411	Underground salt mine.	Wayne.
Kaiser Aluminum & Chemical Corp.	900 17th St., NW. Washington, D.C. 20006	Processing plant: Magnesium compounds.	Midland.
Manistee Salt Works Division Hardy Salt Co.	P.O. Drawer 449 St. Louis, Mo. 63166	Processing plant: Salt	Manistee.
Michigan Chemical Corp.:	351 East Ohio St. Chicago, Ill. 60611		
Manistee plant		Processing plant: Bromine.	Do.
St. Louis plant		Brine wells and processing plant: Bromine, calcium compounds, magnesium compounds, and salt.	Gratiot.
Morton Chemical Co., Division Morton International, Inc.	110 North Wacker Dr. Chicago, Ill. 60606	Brine wells and processing plant: Bromine, calcium compounds, and magnesium compounds.	Manistee.
Morton Salt Co., Division Morton International, Inc.:			
Manistee plant		Brine wells and processing plant: Salt.	Do.
St. Clair plant		do	St. Clair.
Pennsalt Chemicals Corp.	3 Penn Center Philadelphia, Pa. 19102	Brine wells and processing plant: Salt.	Wayne.
Standard Lime & Refractories Co., Martin Marietta Corp.	2000 First National Bank Bldg. Baltimore, Md. 21203	Brine wells and processing plant: Magnesium compounds.	Manistee.
Wilkinson Chemical Corp.	Mayville, Mich. 48744	Brine wells and processing plant: Calcium compounds.	Lapeer.
Wyandotte Chemicals Corp.	1609 Biddle Ave. Wyandotte, Mich. 48192	Brine wells and processing plant: Calcium compounds and salt.	Wayne.

See footnote at end of table.

Table 16.—Principal producers [1]—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
American Aggregates Corp	Garst Ave. at Ave. B Greenville, Ohio 45331	Pits; stationary plants	Kalamazoo, Livingston, Macomb, Oakland.
Arrowhead Silica Corp. Manley Bros. Division	128 South 15th St. Chesterton, Ind. 46304	Pit; stationary plant	Berrien.
J. V. Burkett	St. Joseph, Mich. 49085	Pits; portable plants	Berrien, Calhoun, Kent, Lenawee, Newaygo, Van Buren.
Cole Brothers, Cole Brothers Contractors, Inc.	Route 3, Box 346 Battle Creek, Mich. 49017	do	Barry, Calhoun, Kalamazoo, St. Joseph.
Construction Aggregates Corp.	120 South LaSalle St. Chicago, Ill. 60603	Pit; stationary plants	Ottawa.
R. E. Glancy, Inc	1055 South Bay Dr. Tawas City, Mich. 48763	Pit; portable plant	Iosco.
Grand Rapids Gravel Co	2100 Chicago Dr., SW. Grand Rapids, Mich. 49509	Pits; stationary plants	Kent.
Great Lakes Foundry Sand Co.	1217 Francis Palms Bldg. Detroit, Mich. 48201	Pit; stationary plant	Tuscola.
Holloway Sand & Gravel Co., Inc.	29250 Wixom Road, Box 247 Wixom, Mich. 48096	Pits; portable plants	Lenawee, Oakland, Tuscola, Wayne.
Holly Sand & Gravel Plant J. P. Burroughs & Son, Inc.	16240 Tindall Road Davisburg, Mich. 48019	Pit; stationary plant	Oakland.
Koenig Fuel & Supply Co	1486 Gratiot Ave. Detroit, Mich. 48207	do	Do.
Lyon Sand & Gravel Co. Division E. C. Levy Co.	9300 Dix Dearborn, Mich. 48120	do	Do.
Manley Sand Division Martin Marietta Corp.	Rockton, Ill. 61072	do	Berrien.
Mickelson Corp	435 Granger Road Oxford, Mich. 48051	Pit; dredges; portable plant.	Oakland.
Molesworth Contracting Co	321 Park Ave. Yale, Mich. 48097	Pits; portable plants	Genesee, Macomb, St. Clair, Sanilac.
Natural Aggregates Corp	65545 Mound Rd. Romeo, Mich. 48065	Pits; dredge; portable and stationary plants.	Livingston, Macomb.
New Hudson Sand & Gravel, Inc., Texas Industries, Inc.	Box H New Hudson, Mich. 48165	Pits; stationary plants	Oakland.
The Nugent Sand Co., Inc	2875 Lincoln St. Muskegon, Mich. 49441	Pit; stationary plant	Muskegon.
Ottawa Silica Co. Michigan Division.	Box 577 Ottawa, Ill. 61350	do	Wayne.
Pickitt & Schreur, Inc	Box 149 Allegan, Mich. 49010	Pits; portable plants	Allegan, Branch, Calhoun, Charlevoix, Clinton, Kalamazoo, Kent, Ottawa, St. Joseph.
Sand Products Corp	2489 First National Bank Bldg. Detroit, Mich. 48226	Pit; stationary plant	Manistee.
Sargent Sand Co	2840 Bay Rd. Saginaw, Mich. 48604	Pits; stationary plants	Bay, Mason, Saginaw, Tuscola.
I. W. Schworm & Son, Inc	Box 162 Traverse City, Mich. 49684	Pit; stationary plant	Grand Traverse.
Whittaker & Gooding Co	5800 Cherry Hill Rd. Ypsilanti, Mich. 48197	do	Washtenaw.
John G. Yerington	Route 3, Box 34 Benton Harbor, Mich. 49022	Pits; portable plants	Allegan, Barry, Berrien, Cass, Eaton, Kalamazoo, St. Joseph, Van Buren.

See footnote at end of table.

Table 16.—Principal producers[1]—Continued

Commodity and company	Address	Type of activity	County
Silver: White Pine Copper Co.	Box 427 White Pine, Mich. 49971	Byproduct silver	Ontonagon.
Smelters:			
Calumet & Hecla Corp.	Calumet Ave. Calumet, Mich. 49913	Primary copper smelter.	Houghton.
Quincy Mining Co.	Hancock, Mich. 49930	Secondary smelter	Do.
White Pine Copper Co.	Box 427 White Pine, Mich. 49971	Primary copper smelter.	Ontonagon.
Stone:			
Basalt: Houghton County Road Commission.	Hancock, Mich. 49930	Old mine waste	Houghton.
Granite: Crystal Rock Products, Inc.	Box 63 Crystal Falls, Mich. 49920	Quarry; stationary plant.	Dickinson.
Limestone and dolomite:			
Bethlehem Mines Corp. (Bethlehem Steel Corp.)	701 East 3d St. Bethlehem, Pa. 18016	Quarry; stationary plant.	Chippewa.
Dundee Cement Co.	Box 317 Dundee, Mich. 48131	do	Monroe.
The France Stone Co.	1800 Toledo Trust Bldg. Toledo, Ohio 43604	do	Do.
Huron Cement Co., Division of National Gypsum Co.	1325 Ford Bldg. 615 Griswold St. Detroit, Mich. 48226	do	Alpena.
Inland Lime & Stone Co. Division of Inland Steel Co.	Gulliver, Mich. 49840	Quarries; stationary plants.	Mackinac, Schoolcraft.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	Quarry; stationary plant.	Charlevoix.
Michigan Foundation Quarry Co., Inc.	110 West Jefferson Ave. Trenton, Mich. 48183	do	Wayne.
The Michigan Stone Co.	Ottawa Lake, Mich. 49267	Quarries; stationary plants.	Monroe.
Penn-Dixie Cement Corp.	Box 152 Nazareth, Pa. 18064	Quarry; stationary plant.	Emmet.
Presque Isle Corp.	Box 426 Alpena, Mich. 49707	do	Presque Isle.
United States Steel Corp. Michigan Limestone Operations.	Rogers City, Mich. 49779	Quarries; stationary plants.	Mackinac, Presque Isle.
The Wallace Stone Co., Division J. B. Burroughs & Son, Inc.	Bay Port, Mich. 48720	Quarry; stationary plant.	Huron.
Marl:			
Barnett Brothers	South Front St. Dowagiac, Mich. 49047	Pit	Cass.
Case Brothers	Route 2, Box 136 Union City, Mich. 49094	Pit	Calhoun.
Hayward Dry Marl	Route 2 Vicksburg, Mich. 49097	Pit	Kalamazoo.
Poehlman & Son	Route 2 Cassopolis, Mich. 49031	Pit	Cass.
Sandstone: Ray's Stone Quarry.	303 Natawasaeppe St. Napoleon, Mich. 49261	Quarry; finishing plant.	Jackson.
Recovered sulfur:			
Leonard Refineries, Inc. Alma Division.	East Superior St. Alma, Mich. 48801	Byproduct sulfur recovery.	Gratiot.
Marathon Oil Co.	1300 South Fort St. Detroit, Mich. 48217	do	Wayne.
Mobil Oil Co., Inc.	Box 477 Trenton, Mich. 48183	do	Do.
Exfoliated vermiculite: Zonolite Division W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 01109	Processing plant	Do.

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[1] Data regarding producers of natural gas, natural gas liquids, and petroleum not available.

The Mineral Industry of Minnesota

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Minnesota Geological Survey for collecting information on all minerals except fuels.

By Keith S. Olson [1]

Minnesota's 1968 mineral output was valued at $567.4 million, an increase of 8 percent over that of 1967. An increase of $40 million in the value of iron ore output was the major reason for the greater value. Minnesota continued to be the Nation's largest supplier of iron ore, contributing 63 percent of all usable iron ores shipped from mines in the United States. Iron-bearing ores (including manganiferous ores) accounted for 90 percent of the total value of 1968 State mineral output. Growing demand for high-quality blast furnace feed was evidenced by the fact that, for the first time, shipments of taconite pellets comprised more than half of the State's total iron ore shipments. The quantity and value of the output of abrasive stone, clays (excluding fire clay), iron ore, lime, sand and gravel, and stone increased. Production of fire clay, portland and masonry cements, manganiferous ore, and peat decreased in quantity and value from that of 1967.

In 1968, one or more mineral commodities were produced in each of Minnesota's 87 counties. Because of their large-scale iron ore operations, St. Louis and Itasca Counties ranked first and second in value of mineral output with 77 percent and 13 percent of the State total, respectively. In addition to these two counties, 12 other counties had mineral production exceeding $1 million.

Interest continued in the possible utilization of copper-nickel resources in northern Minnesota. Principal activities in 1968 consisted of exploration drilling and acquisition of leases on State-owned lands.

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[1] Industry economist, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Minnesota [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] thousand short tons	228	$342	240	$359
Iron ore (usable) thousand long tons, gross weight	49,457	468,628	51,275	508,814
Manganiferous ore (5 to 35 percent Mn) short tons, gross weight	236,753	W	191,846	W
Peat short tons	13,968	257	6,400	96
Sand and gravel thousand short tons	41,212	33,132	44,674	36,414
Stone do	4,160	11,442	4,427	13,045
Value of items that cannot be disclosed: Abrasive stone, cement, fire clay, gem stones, lime, and values indicated by symbol W	XX	9,530	XX	8,699
Total	XX	523,326	XX	567,427
Total 1957–59 constant dollars	XX	443,695	XX	ᵖ 474,695

ᵖ Preliminary. XX Not applicable.

W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fire clay included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Minnesota, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Aitkin	$318	$41	Sand and gravel, peat.
Anoka	W	W	Sand and gravel.
Becker	512	460	Sand and gravel. peat.
Beltrami	103	258	Sand and gravel.
Benton	200	W	Do.
Big Stone	555	731	Stone, sand and gravel.
Blue Earth	1,717	1,518	Do.
Brown	211	417	Sand and gravel, clays.
Carlton	382	431	Sand and gravel, peat, clays.
Carver	510	750	Sand and gravel, lime.
Cass	204	92	Sand and gravel.
Chippewa	329	178	Do.
Chisago	257	114	Do.
Clay	2,167	2,689	Sand and gravel, lime.
Clearwater	138	678	Sand and gravel.
Cook	128	W	Do.
Cottonwood	W	91	Do.
Crow Wing	7,491	5,450	Iron ore, manganiferous ore, sand and gravel.
Dakota	2,878	3,239	Sand and gravel, stone.
Dodge	W	W	Stone, sand and gravel.
Douglas	468	325	Sand and gravel.
Faribault	101	151	Do.
Fillmore	2,558	1,174	Iron ore, stone, sand and gravel.
Freeborn	368	396	Sand and gravel.
Goodhue	437	637	Sand and gravel, stone, clays.
Grant	197	168	Sand and gravel.
Hennepin	3,828	4,423	Sand and gravel, clays.
Houston	220	W	Stone.
Hubbard	6	39	Sand and gravel.
Isanti	W	W	Do.
Itasca	65,703	73,808	Iron ore, sand and gravel, peat.
Jackson	47	163	Sand and gravel.
Kanabec	132	W	Sand and gravel, stone.
Kandiyohi	640	545	Sand and gravel.
Kittson	53	19	Do.
Koochiching	141	108	Do.
Lac qui Parle	686	520	Stone, sand and gravel.
Lake	242	143	Sand and gravel.
Lake of the Woods	292	47	Do.
Le Sueur	2,161	2,270	Sand and gravel, stone.
Lincoln	173	157	Sand and gravel.
Lyon	202	409	Do.
McLeod	312	271	Do.
Mahnomen	W	W	Do.
Marshall	W	210	Do.
Martin	213	178	Do.
Meeker	205	170	Do.
Mille Lacs	252	470	Stone, sand and gravel.
Morrison	280	405	Sand and gravel.
Mower	527	728	Stone, sand and gravel.
Murray	W	96	Sand and gravel.
Nicollet	946	861	Sand and gravel, stone.
Nobles	208	576	Sand and gravel.
Norman	71	41	Do.
Olmsted	W	1,067	Stone, sand and gravel.
Otter Tail	366	1,091	Sand and gravel.
Pennington	42	11	Do.
Pine	228	53	Sand and gravel, peat.
Pipestone	193	73	Sand and gravel.
Polk	1,009	1,791	Sand and gravel, lime.
Pope	249	108	Sand and gravel.
Ramsey	W	W	Sand and gravel, clays.
Red Lake	41	102	Sand and gravel.
Redwood	422	329	Sand and gravel, stone, clays.
Renville	666	766	Sand and gravel, stone.
Rice	387	407	Do.
Rock	912	983	Sand and gravel, abrasives, stone.
Roseau	123	W	Sand and gravel.
St. Louis	404,498	438,407	Iron ore, cement, sand and gravel, lime, stone, peat.
Scott	1,026	960	Stone, sand and gravel.
Sherburne	308	563	Sand and gravel.
Sibley	132	178	Do.
Stearns	4,238	5,154	Stone, sand and gravel.
Steele	463	484	Sand and gravel, stone.
Stevens	115	133	Sand and gravel.
Swift	115	36	Do.

See footnotes at end of table.

Table 2.—Value of mineral production in Minnesota, by counties—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Todd	$98	$434	Sand and gravel.
Traverse	W	57	Do.
Wabasha	231	276	Stone, sand and gravel.
Wadena	W	72	Sand and gravel, stone.
Waseca	W	60	Sand and gravel.
Washington	3,349	3,242	Sand and gravel, stone.
Watonwan	6	69	Sand and gravel.
Wilkin	150	148	Do.
Winona	943	W	Stone, sand and gravel.
Wright	290	530	Sand and gravel.
Yellow Medicine	340	294	Sand and gravel, stone.
Undistributed [1]	2,619	2,955	
Total [2]	523,326	567,427	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes some sand and gravel and stone that cannot be assigned to specific counties and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Minnesota business activity

	1967	1968	Change (percent)
Employment and labor force, annual average:[1]			
Total labor force thousands	r 1,601.5	1,634.3	+2.0
Agricultural employment do	199.9	192.8	−3.6
Nonagricultural employment [2] do	r 1,350.2	1,390.2	+3.0
Manufacturing do	r 302.8	312.8	+3.3
Construction do	r 61.1	63.7	+4.3
Mining and quarrying do	14.4	15.2	+5.6
Metal mining do	12.8	13.4	+4.7
Stone, clay, and glass products do	r 7.3	7.4	+1.4
Primary metal industries do	7.0	6.9	−1.4
All other do	971.9	998.5	+2.7
Payroll data: Manufacturing [3] millions	$2,095.1	$2,323.7	+10.9
Personal income:			
Total do	$11,162	p $12,102	+8.4
Per capita	$3,079	p $3,318	+7.8
Construction activity:			
Building permits:[4]			
Valuation of authorized residential construction millions	$321.0	$451.3	+40.6
Number of private and public residential building units authorized	23,491	30,771	+31.0
Contract construction work performed:			
Total millions	r $925	$1,291	+39.6
Nonresidential building do	$345	$413	+19.7
Residential building do	r $383	$527	+37.6
Nonbuilding do	$197	$351	+78.2
State highway commission contracts awarded do	$114.1	$119.6	+4.8
Portland cement shipments to and within Minnesota thousand 376-pound barrels	8,366	8,764	+4.8
Retail sales millions	$6,094	$6,489	+6.5
Farm marketing receipts do	r $1,831	p $1,813	−1.0
Mineral production do	$523.3	$567.4	+8.4
Utility production and consumption:			
Production of electric energy by electric utilities million kilowatt hours	13,925	p 15,823	+13.6
Natural gas consumption million cubic feet	283,086	311,898	+10.2
International trade:[5]			
Value of exports through Minnesota millions	$286.5	$292.1	+2.0
Value of imports through Minnesota do	$414.9	$506.9	+22.2

p Preliminary. r Revised.

[1] Adjusted to March 1968 benchmark levels.

[2] Includes nonagricultural wage and salary, self-employed, unpaid family workers, and domestic workers in private households.

[3] Includes workers covered under the Minnesota Employment Security Law.

[4] Based on a Nationwide survey of 13,000 permit-issuing places.

[5] Includes Duluth and Minneapolis-St. Paul Customs Districts.

Sources: Minnesota Department of Employment Security in cooperation with U.S. Department of Labor, Survey of Current Business, Construction Reports, Statistical Abstract of the United States, Minnesota Department of Highways, Sales Management, Farm Income Situation, Federal Power Commission, and U.S. Department of Commerce.

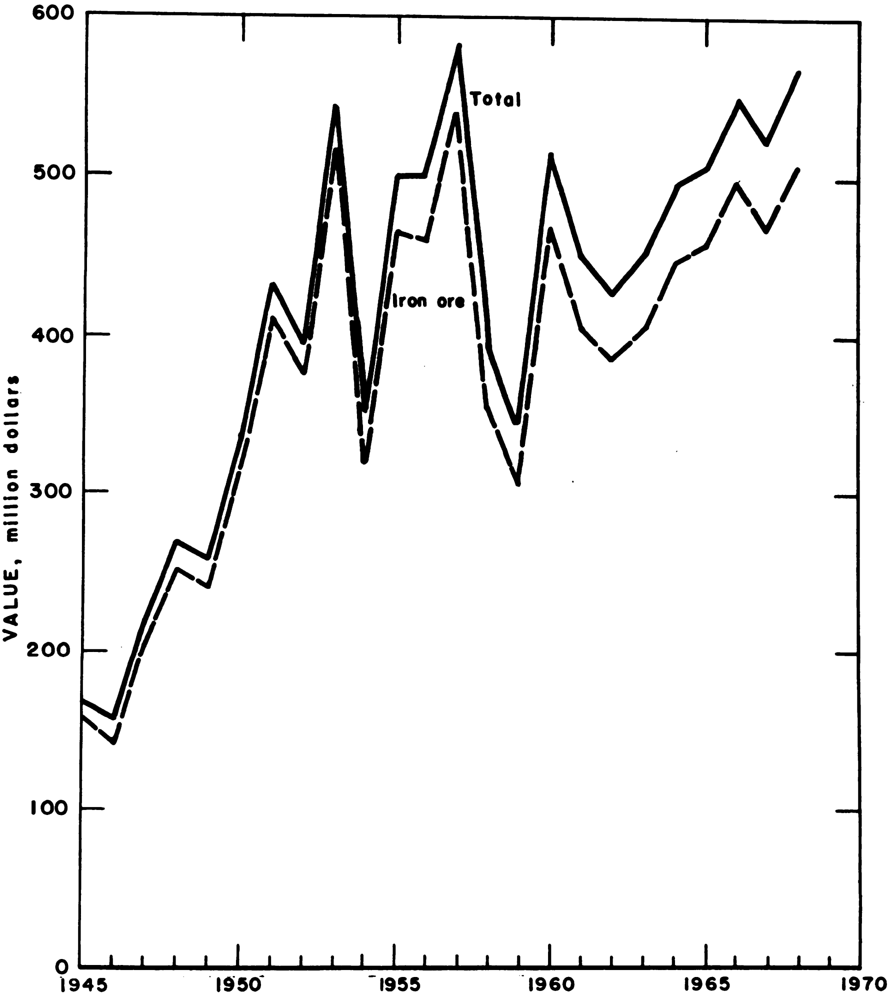

Figure 1.—Value of iron-ore shipments and total value of mineral production in Minnesota.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1967:								
Peat	30	115	3	25	------	1	39.70	397
Metal	9,378	294	2,758	22,073	6	79	3.85	2,100
Nonmetal	208	261	54	436	------	21	48.16	2,032
Sand and gravel	2,200	173	380	3,427	1	58	17.22	2,404
Stone	1,450	261	379	3,095	------	47	15.19	447
Total [1]	13,266	269	3,575	29,055	7	206	7.33	1,958
1968:[p]								
Peat	37	153	6	26	------	2	78.25	861
Metal	9,025	315	2,856	22,867	4	87	3.98	1,441
Nonmetal	155	263	41	332	------	12	36.19	205
Sand and gravel	2,145	171	367	3,282	1	59	18.28	2,252
Stone	1,415	264	373	3,060	------	55	17.98	1,663
Total [1]	12,780	284	3,644	29,566	5	215	7.44	1,540

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

METALS

Copper-Nickel.—Interest in copper-nickel deposits was concentrated in areas along the Duluth Gabbro in Cook, Lake, and St. Louis Counties and on lands underlain by the Greenstone Formations in Koochiching, Itasca, Lake of the Woods, and St. Louis Counties. The International Nickel Co., Inc., sealed its exploration shaft near Ely upon completion of its preliminary underground development program. In March, the company stated that its properties near Ely could not be developed at that time due to the low metal content and the complex mineralogy of the deposit. However, the company is continuing its exploration activities at several other locations in northern Minnesota.

The State of Minnesota held sales of leases in August and December for exploration and mining of copper-nickel and associated minerals on 146,000 acres of State lands in Koochiching, Itasca, Lake of the Woods, and St. Louis Counties. Successful bidders in August were Humble Oil & Refining Co. and Texas Gulf Sulphur Co. In December, leases were granted to Bear Creek Mining Co. (exploration division of Kennecott Copper Corp.); The Hanna Mining Co.; Humble Oil & Refining Co.; W. S. Moore Company; The New Jersey Zinc Co.; and United States Steel Corp.

Other major companies exploring for copper-nickel and associated minerals and/or holding copper-nickel leases included: AMAX Exploration, Inc.; American Smelting & Refining Company; Cerro Exploration Co., Inc.; Cominco American, Inc.; Cleveland-Cliffs Iron Co.; Duval Corp.; Newmont Exploration Ltd.; and Phelps Dodge Corp.

The University of Minnesota Mines Experiment Station studied flotation processes for the concentration of copper-nickel ores.

Iron Ore.—Minnesota mines shipped 51.3 million long tons of usable iron ore (excluding ore containing 5 percent or more manganese, natural) in 1968, an increase of nearly 4 percent over that of 1967. Total value of shipments increased 9 percent, chiefly because of the higher proportion of taconite pellets shipped. Shipments of taconite pellets were 29.8 million long tons, comprising 58 percent of the total State iron ore shipments. More than 90 percent of the usable iron ore shipped in 1968 consisted of concentrates; the remainder was direct-shipping ore. Average iron content of usable ore produced was 58.3 percent, compared with 57.3 percent in 1967.

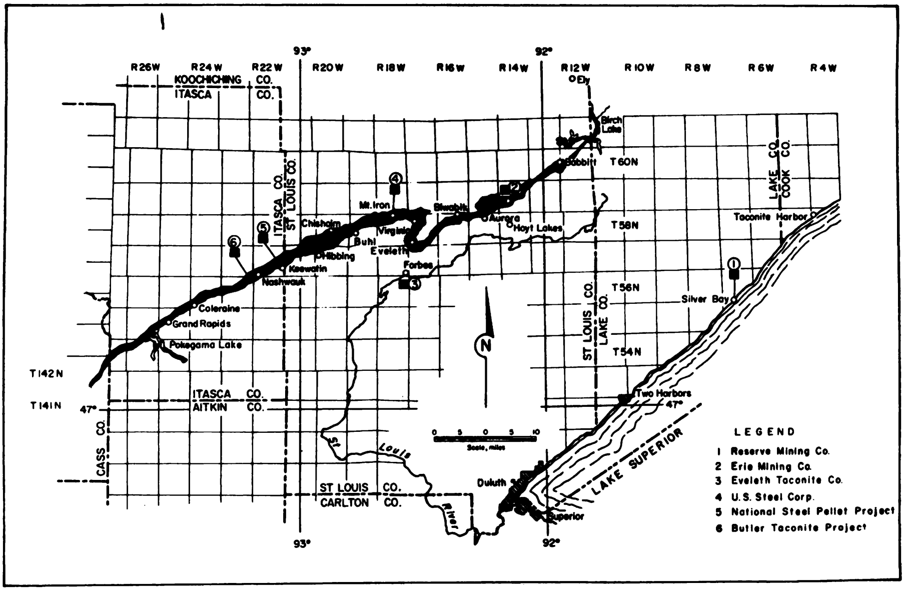

Figure 2.—Location of Mesabi Range Taconite-processing plants.

Lake Erie base prices for iron ore remained unchanged from 1967. Average weighted mine value of Minnesota iron ore increased to $9.92 per ton, compared with $9.48 per ton in 1967.

Nearly all Minnesota iron ore was used for pig iron and steel manufacturing. A small quantity was sold for cement manufacture and foundry purposes.

Iron ore was produced by 12 companies operating mines on the Mesabi Range in Itasca and St. Louis Counties, the Cuyuna Range in Crow Wing County, and the Spring Valley district in Fillmore County. All iron mining in 1968 was by open-pit methods. The Mesabi Range accounted for 99 percent of Minnesota's 1968 iron ore shipments.

United States Steel Corp. completed the first year of operation at its 4.5-million-ton-per-year Minntac plant near Mountain Iron and produced its 5-millionth ton of taconite pellets in December. Crude ore for the operation was mined at the Minntac mine located 3½ miles west of the plant. Overburden stripping generally was to be done about 2 years ahead of production. All blast hole drilling was by rotary methods using tungsten carbide bits. Ore was transported by rail from the mine to the two 60- by 110-inch primary crushers located at the plant site. Methods of production are nearly the same as those employed at the nearby Pilotac concentrator which also produced concentrates for agglomeration at the Minntac plant. The pelletizing section consists of three grate-kiln lines, each containing an 8- by 120-foot rotary kiln. The Minntac operation was designed for future expansion in multiple steps if warranted by future economic conditions.

Pellets were transported to Duluth, Missabe & Iron Range Railroad (D.M. & I.R.) docks at Duluth by 100-car trains on a two-train-per-day basis. Occasionally shipments were also made to the D.M. & I.R. docks at Two Harbors. During the winter months, pellets were stored at the D.M. & I.R.'s Lakehead storage facility in Duluth.

The Hanna Mining Co. began building a new pelletizing section at its National Steel Pellet Plant near Keewatin after the original indurating process proved unsatisfactory. The new pelletizing section, incorporating a traveling grate furnace and rotary kiln, is nearly identical to the indurating section of the company's Butler Taconite Project, near Nashwauk. Production at the National Steel Plant was halted in September to allow for construction of the new section. The plant was expected to resume pellet production in March 1969. Production at the Butler plant exceeded its rated annual production capacity by 20 percent in 1968. In October, the company began updating its fleet of 34- and 40-ton haulage trucks at the Butler operation with new 100-ton-capacity haulage vehicles.

Reserve Mining Co. operated its Peter Mitchell mine near Babbitt. Crude ore was crushed to 3-inch size at the mine and shipped 47 miles on the company-owned railroad to the company's E. W. Davis Works at Silver Bay for further crushing, concentrating, agglomerating, and shipping. In 1968, the company shipped 9.5 million tons of taconite pellets.

Erie Mining Co. (Pickands Mather & Co., operating agents) produced 10.7 million tons of taconite pellets at its Hoyt Lakes plant, the largest output of any year since the plant began production in 1957. Pellets were shipped 74 miles on the company-owned railroad to Taconite Harbor for lake shipment to lower Lake ports.

Eveleth Taconite Co., owned jointly by Ford Motor Co. (85 percent) and Oglebay Norton Co. (15 percent), produced 1.8 million tons of taconite pellets in 1968.

Annual rated capacity of Minnesota's taconite plants was 32 million tons per year.

Natural ore mines producing more than 1 million tons of usable ore in 1968 were the Plummer group, Rouchleau group, Sherman group, and the Stephens mine, all operated by United States Steel Corp.; and the Pierce group and South Agnew mine operated by The Hanna Mining Co. All except the Plummer group are in St. Louis County.

United States Steel Corp. installed additional ore washing facilities at its Sherman plant. At its Twin City property near Buhl, the company began a stripping program which will eventually require the removal of about 12 million tons of overburden at depths of up to 190 feet. Initial production from this property was scheduled to begin in 1970 as part of the Sherman mine complex.

The Hanna Mining Co. leased the West Hill mine near Coleraine late in the year. At its Pierce mine near Hibbing, the company began construction of a rescreening plant, scheduled to be in operation in May 1969. Mining operations were discontinued at Hanna's South Agnew mine, on the Mesabi Range near Hibbing, and the Rabbit Lake mine near Cuyuna Village on the Cuyuna Range. Hanna expected to continue production of concentrates from stockpiled crude ore at the South Agnew. Shipments of concentrates from stockpiles were to be made from the Rabbit Lake mine.

In April, Jones & Laughlin Steel Corp. began production at its new 1.5-million-ton-per-year natural ore mine and treatment plant, near McKinley. Two sizes of beneficiated ore were produced—a plus ⅜-inch for direct blast furnace consumption and a minus ⅜-inch for sinter production.

Pacific Isle Mining Co., a subsidiary of Inland Steel Co., suspended mining operations at the end of 1968.

Shipments and production of iron ore from the Cuyuna Range decreased 34 percent and 8 percent, respectively, from those of 1967. Shipments were by rail from Ironton to the Northern Pacific Railway Co. ore docks at Superior, Wis. Iron ore shipments from the Spring Valley district were about one-third those of 1967. All shipments were by rail, mainly to consuming furnaces at Granite City, Illinois, with lesser amounts sold for cement manufacturing.

The navigation season for Lake Superior ports shipping Minnesota iron ores began April 1 at Duluth and Silver Bay. For the first time on record, lake shipments of Minnesota iron ore extended into the following year. The final shipment, consisting of taconite pellets, left Two Harbors on January 3, 1969. The new Poe lock at Sault Ste. Marie, Michigan, opened in October 1968, has made possible the use of ore carriers much larger than those currently in service on the Great Lakes. The first two of these large vessels, designed for more economical transportation of iron ore, are scheduled for operation in the 1970 shipping season. Bethlehem Steel Corp. was planning a 52,000-gross-ton-capacity ore carrier with a length of 1,000 feet and a beam of 105 feet. United States Steel Corp. was building a cargo vessel 805 feet long with a 105-foot beam capable of carrying 45,000 gross tons.

Table 5.—Crude iron ore[1] data in 1968, by counties and ranges

(Thousand long tons)

County and range	Stocks Jan. 1	Production[2]	Shipments: Direct to consumers	Shipments: To concentrators	Stocks Dec. 31
County:					
Crow Wing	r 42	1,314	42	1,314	---------
Fillmore	---------	60	---------	60	---------
Itasca	---------	21,798	---------	21,798	---------
St. Louis	858	104,209	5,002	98,732	1,333
Total[3]	r 900	127,380	5,044	121,904	1,333
Range:					
Cuyuna	r 42	1,314	42	1,314	---------
Mesabi	858	126,006	5,002	120,530	1,333
Spring Valley district	---------	60	---------	60	---------
Total	r 900	127,380	5,044	121,904	1,333

r Revised.

[1] Exclusive of ore containing 5 percent or more manganese.

[2] Entire production from open-pit mines.

[3] Data may not add to totals shown because of independent rounding.

Table 6.—Usable iron ore[1] data in 1968, by counties and ranges

(Thousand long tons)

County and range	Stocks Jan. 1	Production	Iron content of production	Shipments	Stocks Dec. 31
County:					
Crow Wing	r 324	961	494	526	758
Fillmore	40	83	39	109	15
Itasca	1,127	7,641	4,456	7,891	876
St. Louis	3,873	43,770	25,607	42,749	4,894
Total[2]	r 5,364	52,454	30,597	51,275	6,543
Range:					
Cuyuna	r 324	961	494	526	758
Mesabi	5,000	51,411	30,064	50,640	5,770
Spring Valley district	40	83	39	109	15
Total[2]	r 5,364	52,454	30,597	51,275	6,543

r Revised.

[1] Exclusive of ore containing 5 percent or more manganese.

[2] Data may not add to totals shown because of independent rounding.

Table 7.—Usable iron ore[1] produced (direct-shipping and all forms of concentrate), by ranges

(Thousand long tons)

Year	Cuyuna	Mesabi	Vermilion	Spring Valley District	Total [2]
1884–1963	66,155	2,415,868	100,974	6,191	2,589,188
1964	513	47,256	865	420	49,054
1965	367	50,279	782	625	52,053
1966	1,299	51,506	704	772	54,280
1967	1,041	48,857	202	58	50,157
1968	961	51,411	-------	83	52,454
Total [2]	70,335	2,665,176	103,527	8,149	2,847,187

[1] Exclusive, after 1905, of iron ore containing 5 percent or more manganese.
[2] Data may not add to totals shown because of independent rounding.

Table 8.—Production of usable iron ore

(Thousand long tons)

Year	Gross weight		Iron content (percent)	Year	Gross weight		Iron content (percent)
	Ore	Iron content			Ore	Iron content	
1964	49,054	27,660	56.39	1967	50,157	28,742	57.30
1965	52,053	29,510	56.69	1968	52,454	30,597	58.33
1966	54,280	30,625	56.42				

Table 9.—Iron ore[1] shipped from mines

(Thousand long tons)

Year	Direct-shipping ore [2]	Concentrates			Total usable ore [3]	Proportion of concentrates to total usable ore (percent)
		Agglomerates	Other	Total [3]		
1964	10,441	19,267	19,917	39,184	49,626	78.96
1965	11,579	19,039	20,255	39,294	50,873	77.24
1966	12,863	21,580	20,690	42,270	55,133	76.67
1967	11,149	23,884	14,424	38,308	49,457	77.46
1968	5,044	29,751	16,481	46,231	51,275	90.16

[1] Exclusive of ore containing 5 percent or more manganese.
[2] Includes crushed, screened, and sized ore not further treated.
[3] Data may not add to totals shown because of independent rounding.

Table 10.—Dates of first and final cargoes of iron ore at U.S. upper Great Lakes ports

Port and dock	1967		1968	
	First	Final	First	Final
Duluth, Minn.: DM&IR	Apr. 12	Dec. 11	Apr. 1	Dec. 14
Escanaba, Mich.: C&NW	Apr. 7	Dec. 22	Mar. 31	Dec. 19
Marquette, Mich.:				
Soo Line	May 9	Nov. 14	Apr. 12	Nov. 1
LS&I	Apr. 15	Dec. 16	Apr. 10	Dec. 18
Silver Bay, Minn.: Reserve	Apr. 15	Dec. 10	Apr. 1	Dec. 5
Superior, Wis.:				
GN	Apr. 14	Dec. 17	Apr. 14	Dec. 15
NP-Soo Line	May 2	Oct. 25	May 3	Sept. 28
Taconite Harbor, Minn.: Erie	Apr. 12	Dec. 8	Apr. 9	Dec. 14
Two Harbors, Minn.: DM&IR	May 15	Dec. 28	Apr. 23	Jan. 3 [1]

[1] Jan. 3, 1969.

Source: Skillings' Mining Review.

Nearly 97 percent of the iron ore shipments from Minnesota were by lake vessel to lower Lake ports and thence to consuming furnaces. The remainder was transported by rail.

A new firm, Hallett Harrison Co., studied the economic feasibility of a custom iron ore pelletizing plant at Duluth.

Three agencies of the U.S. Department of the Interior—the Bureau of Commercial Fisheries, Federal Water Pollution Control Administration, and the Bureau of Mines—and the U.S. Army Corps of Engineers studied the effects of Reserve Mining Co.'s disposal of taconite tailings in Lake Superior.

The University of Minnesota Mines Experiment Station continued its research on the beneficiation and pelletizing of Minnesota iron ores.

Research conducted by the U.S. Bureau of Mines at its Twin Cities Metallurgy Research Center and at the Iron Range demonstration plant near Keewatin included beneficiation of nonmagnetic and low-grade iron ore by flotation; preparation of prereduced and oxide iron ore pellets; study of various binding agents for iron ore pellets; production of low-silica concentrates; and utilization of ferrous scrap as a reductant for magnetic roasting of various iron ores. Because of government-wide budget cuts, construction on the Bureau's Iron Range demonstration plant came to a halt in mid-1968.

Iron and Steel.—Basic pig iron and steel were produced at Duluth by American Steel & Wire Division of United States Steel Corp. During periods of maximum production, the company operated two blast furnaces. North Star Steel Corp. produced steel from ferrous scrap at its 50-ton-capacity electric furnace in St. Paul.

Manganiferous Ore.—Two companies shipped 171,291 long tons of manganiferous ore (ore containing 5 to 35 percent manganese, natural) concentrates from five properties on the Cuyuna Range in Crow Wing County. Shipments were 19 percent less than those of 1967. Ninety-nine percent of the shipments were ferruginous manganese ore (ore containing 10 to 35 percent manganese, natural).

The Hanna Mining Co. made shipments from the Algoma mine, and Pittsburgh Pacific Co. shipped from the Louise, Mangan No. 1, Sagamore, and Sultana properties. Production resumed at the Louise mine, which was converted from an underground to an open-pit operation after being idle since 1961. Shipments from the other operations were entirely from stocks.

The Hanna Mining Co. began developing the Lauretta property (also known as the Gloria-Zeno) which will include stripping about 1 million cubic yards of overburden and construction of a crushing and screening plant. Production was scheduled to begin in 1969.

The University of Minnesota Mines Experiment Station studied the recovery of manganese from Cuyuna Range manganiferous ores by bacterial leaching.

The U.S. Bureau of Mines studied the recovery of both iron and manganese products from low-grade Cuyuna Range ores at its Twin Cities Metallurgy Research Center.

Table 11.—Shipments of usable[1] manganiferous iron ore and ferruginous manganese ore from mines in the Cuyuna Range

Year	Manganiferous iron ore (5 to 10 percent Mn, natural)			Ferruginous manganese ore (10 to 35 percent Mn, natural)			Total shipments (long tons)
	Shipments (long tons)	Contents (natural)		Shipments (long tons)	Contents (natural)		
		Fe (percent)	Mn (percent)		Fe (percent)	Mn (percent)	
1964	27,725	36.59	9.68	140,562	32.61	12.38	168,287
1965	32,935	33.99	7.27	217,695	35.47	12.75	250,630
1966	4,035	33.55	8.61	242,020	33.87	14.12	246,055
1967	---------	---------	---------	211,387	32.88	14.56	211,387
1968	1,596	39.89	6.88	169,695	33.15	14.23	171,291

[1] Direct-shipping and beneficiated ore.

NONMETALS

Abrasive Stone.—Grinding pebbles and tube-mill liners were produced by Jasper Stone Co. from a quartzite deposit in Rock County. Sales of both types of material increased in quantity and value.

Cement.—Shipments of portland and masonry cements decreased in both quantity and value from those of 1967. The major reason for the decline was a lesser amount of material sold for highway construction than sold in 1967. Universal Atlas Cement Division of United States Steel Corp., the State's only producer, operated three rotary kilns, producing types I and II (general use and moderate heat), type III (high-early-strength), portland slag, and masonry cements. Raw materials used in the manufacturing process included limestone, slag from the nearby U.S. Steel blast furnaces, sand, gypsum, iron dust, and air-entraining compounds. Shipments were primarily to Minnesota with lesser shipments to Michigan, North Dakota, South Dakota, and Wisconsin. Most of the portland cement was shipped in bulk form, the remainder in bags. Although State cement production decreased, total shipments of portland cement to and within Minnesota increased to 8.8 million barrels, 5 percent over those of 1967. The major portion of cement shipments into Minnesota from plants in other States came from Iowa and Michigan, with lesser amounts from 10 other States. Shipments of masonry cement to and within Minnesota was nearly 455,000 barrels, an increase of 9 percent over those of 1967.

Clays.—Production of miscellaneous clay and shale increased 5 percent in quantity and value, chiefly because of a greater demand for material used in making building brick and lightweight aggregate. Production was reported from Brown, Carlton, Hennepin, Ramsey, and Redwood Counties. A small amount of clay was used for making floor and wall tile. Output of fire clay, all from Goodhue County and used entirely for making vitrified sewer pipe, decreased sharply from that of 1967 because of greater use of Iowa clay.

The Minnesota Geological Survey completed its study of the clay resources of the State. The purpose of the study was to provide geologic data useful in developing Minnesota's clay resources. A report on the clay mineralogy, fabric, and industrial uses of the Decorah Shale in southeastern Minnesota was published.[2] A report describing a Bureau of Mines investigation of the glacial Lake Agassiz basin in St. Louis County was published.[3]

Gem Stones.—Minor quantities of semiprecious gem stones, principally agates, were collected by hobbyists. Gem materials were found chiefly along the north shore of Lake Superior, along the Mississippi River, and in gravel pits in the southeastern part of the State. The material was used principally for handmade jewelry and personal collections.

Lime.—Increases in the amount of lime used for construction and sugar refining resulted in increases of 25 percent in quantity and 33 percent in value of Minnesota lime production. American Crystal Sugar Co. produced quicklime for sugar refining at its plants near Chaska, Carver County; Moorhead, Clay County; and Crookston and East Grand Forks, Polk County. Shaft kilns, using coke as fuel, were operated at these plants. The State's only commercial lime plant was operated by Cutler-Magner Co. at Duluth. Limestone from Michigan was burned in a rotary kiln, utilizing bituminous coal as fuel. Lime shipments, in descending order of quantity, were made to North Dakota, Wisconsin, Iowa, Montana, South Dakota, and Michigan. In addition to lime produced and consumed in Minnesota, shipments were received from plants in Illinois, Iowa, Missouri, Ohio, and Wisconsin. Nearly 190,000 tons of lime were shipped to and within Minnesota.

Perlite.—Crude perlite mined outside the State was expanded by Zonolite Division, W. R. Grace & Co., at its plant in Minneapolis, Hennepin County. This company was the only producer of expanded perlite in Minnesota. Sales of the expanded product decreased in quantity and increased in value from those of 1967. Material was used for building plaster, concrete aggregate, loose fill insulation, soil conditioning, paint additive, textured granules, and foundry purposes.

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[2] Parham, W. E., and G. S. Austin. Clay Mineralogy, Fabric, and Industrial Uses of the Shale of the Decorah Formation, Southeastern Minnesota. Minnesota Geol. Survey, Rept. of Inv. 10, 1969, 32 pp.

[3] Aase, J. H., and G. E. Leonhard. Field Investigation and Testing of a Minnesota Clay Resource for Iron Ore Pellet Bonding. BuMines Rept. of Inv. 7206, 1968, 17 pp.

Sand and Gravel.—Increased demand for sand and gravel in road construction and paving were the primary reasons for increases of 8 percent in quantity and 10 percent in value of sand and gravel production. Output of 44.7 million tons set a new record, surpassing the previous high recorded in 1967. Nearly 5 percent of the Nation's 1968 sand and gravel output was produced in Minnesota.

Nearly 75 percent of the total output was used for road construction, 19 percent for building, 4 percent for fill, and the remainder for other purposes, including industrial sand used for blast, engine, filler, foundry, glassmaking, molding, oil (hydrafrac), porcelain, pottery, and other purposes. Output of industrial sands increased 3 percent in quantity and value over that of 1967. Average value of sand and gravel increased from $0.80 per ton in 1967 to $0.82 per ton in 1968.

Sand and gravel production was recorded from every county in the State except Houston County. Counties producing more than 1 million tons of sand and gravel, in descending order of production, were Hennepin, Dakota, Washington, St. Louis, Stearns, Clay, Otter Tail, and Polk.

Table 12.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,922	$3,312	4,766	$4,189
Paving	3,679	2,340	2,824	2,072
Fill	1,038	491	707	332
Other [1]	516	1,353	578	1,415
Total	9,155	7,496	8,875	8,008
Gravel:				
Building	3,254	5,387	3,664	6,300
Paving	17,943	13,802	23,951	17,123
Railroad ballast	180	114	405	252
Fill	1,174	486	954	426
Other	15	16	10	12
Total	22,566	19,805	28,984	24,113
Total sand and gravel	31,721	27,301	37,859	32,121
Government-and-contractor operations:				
Sand:				
Paving	1,449	794	1,176	726
Fill	103	48	57	25
Other	49	27	17	8
Total	1,601	869	1,250	759
Gravel:				
Building	3	2	--------	--------
Paving	7,708	4,882	5,420	3,475
Fill	179	78	142	58
Other	--------	--------	3	1
Total	7,890	4,962	5,565	3,534
Total sand and gravel	9,491	[2] 5,831	6,815	[2] 4,293
All operations:				
Sand	10,756	8,365	10,125	8,767
Gravel	30,456	24,767	34,549	27,647
Total	41,212	33,182	44,674	36,414

[1] Includes pottery, porcelain, and tile (1967), blast, engine, filler, foundry, glass, molding, oil (hydrafrac), and other construction and industrial uses.

[2] Final figure; supersedes figure given in commodity chapter.

Table 13.—Production of sand and gravel, by counties

(Thousand short tons and thousand dollars)

County	1967		1968	
	Quantity	Value	Quantity	Value
Aitkin	450	$303	65	W
Anoka	W	W	W	W
Becker	556	W	476	W
Beltrami	171	103	429	$258
Benton	236	200	100	W
Big Stone	284	W	164	108
Blue Earth	623	526	602	549
Brown	186	W	458	W
Carlton	357	W	678	W
Carver	470	W	487	425
Cass	315	W	130	92
Chippewa	412	329	244	178
Chisago	510	257	240	114
Clay	1,282	W	1,609	W
Clearwater	213	138	640	678
Cook	201	128	196	W
Cottonwood	301	W	141	91
Crow Wing	190	182	467	338
Dakota	3,283	W	3,552	2,772
Dodge	W	W	W	W
Douglas	831	468	618	325
Faribault	109	101	158	151
Fillmore	99	65	32	W
Freeborn	599	368	566	396
Goodhue	107	W	375	W
Grant	404	197	327	168
Hennepin	4,798	W	5,519	W
Houston	------	------	------	------
Hubbard	10	6	73	39
Isanti	W	W	W	W
Itasca	663	345	781	442
Jackson	60	47	228	163
Kanabec	166	132	20	11
Kandiyohi	582	640	463	545
Kittson	86	53	39	19
Koochiching	181	141	119	108
Lac qui Parle	168	W	119	79
Lake	455	242	263	143
Lake of the Woods	467	292	76	47
Le Sueur	883	1,437	750	W
Lincoln	278	173	251	157
Lyon	222	202	580	409
McLeod	310	312	340	271
Mahnomen	W	W	W	W
Marshall	W	W	341	210
Martin	294	$218	266	$178
Meeker	217	205	197	170
Mille Lacs	128	W	330	W
Morrison	399	280	657	405
Mower	357	183	300	176
Murray	184	W	157	96
Nicollet	795	W	612	W
Nobles	326	208	984	576
Norman	125	71	76	41
Olmsted	318	W	475	383
Otter Tail	470	W	1,308	1,091
Pennington	66	42	20	11
Pine	383	228	87	52
Pipestone	393	193	102	73
Polk	637	W	1,248	W
Pope	315	249	167	108
Ramsey	541	531	616	585
Red Lake	54	41	140	102
Redwood	550	W	375	W
Renville	480	W	529	W
Rice	558	W	582	381
Rock	710	W	912	W
Roseau	228	123	W	W
St. Louis	2,896	2,116	2,290	1,704
Scott	461	415	209	162
Sherburne	307	308	517	563
Sibley	122	132	189	178
Stearns	1,305	W	1,625	1,382
Steele	445	W	389	W
Stevens	137	115	155	133
Swift	201	115	67	36
Todd	182	98	794	434
Traverse	W	W	112	57
Wabasha	97	W	80	82
Wadena	121	W	136	69
Waseca	W	W	102	60
Washington	2,803	W	2,557	W
Watonwan	12	6	102	69
Wilkin	292	150	216	148
Winona	W	W	W	W
Wright	434	290	715	530
Yellow Medicine	187	W	215	192
Undistributed [1]	1,164	19,438	1,353	16,951
Total	41,212	33,132	44,674	36,414

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes production for which no county breakdown is available, and data indicated by symbol W.

Collectively, these eight counties comprised 44 percent of the State total. Of the total commercial production, 95 percent was trucked, and the remainder transported by rail and water.

Stone.—Minnesota stone production, consisting of basalt, granite, limestone and dolomite, marl, and quartzite, increased 6 percent in quantity and 14 percent in value. Production of crushed stone increased about 7 percent in quantity and 10 percent in value. Dimension stone production in 1968 increased 18 percent in value but decreased 3 percent in quantity. Average value of crushed and broken stone increased from $1.37 per ton in 1967 to $1.42 in 1968, and average value of dimension stone increased from $12.28 per ton in 1967 to $14.93 in 1968.

Granite comprised about 10 percent of the quantity and 42 percent of the value of all stone produced in the State. Over 444,000 tons, valued at $5.5 million, was produced in eight west-central and central Minnesota counties by eight companies. Counties with the largest production, in descending order of value, were Stearns, Big Stone, and Lac qui Parle. Collectively, these counties accounted for 88 percent of the total value of granite produced in Minnesota.

Table 14.—Granite sold or used by producers, by uses

Use	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough architectural ..... thousand cubic feet	-------	-------	8	$32
Rough monumental ..... do	24	$71	13	44
Dressed architectural (cut) ..... do	177	2,665	190	3,456
Dressed monumental ..... do	70	1,059	60	1,313
Total ..... approximate short tons	22	3,795	23	4,845
Crushed and broken:				
Aggregate and roadstone ..... thousand short tons	121	238	133	252
Railroad ballast ..... do	194	271	175	258
Riprap ..... do	6	9	W	W
Other [1] ..... do	19	159	114	169
Total [2] ..... do	340	678	422	679
Grand total [2] ..... do	363	4,472	444	5,524

W Withheld to avoid disclosing individual company confidential data; included with "Other."

[1] Includes granite for riprap (1968), grit, and stone sand.

[2] Data may not add to totals shown because of independent rounding.

Production of dimension granite remained nearly unchanged in quantity but increased 28 percent in value from that of 1967 mainly because of greater output of dressed stone for architectural and monumental purposes. Finishing plants were operated in Cold Spring, Delano, and St. Cloud. Production of crushed and broken granite increased 24 percent in quantity, whereas the total value remained essentially unchanged. Material was used for concrete and bituminous aggregate, roadstone, railroad ballast, riprap, poultry grit, traction grit, and stone sand.

Limestone and dolomite was produced in 15 counties in southern and eastern Minnesota. Leading counties, in descending order of value of production, were Blue Earth, Le Sueur, Scott, Washington, and Olmsted. These five counties furnished 57 percent of the total value of the State's limestone and dolomite output.

Because of increased demand for aggregate and roadstone, production of crushed and broken limestone and dolomite increased 5 percent in quantity and 11 percent in value over that of 1967. Average value increased from $1.29 per ton in 1967 to $1.37 per ton in 1968. Output of crushed limestone and dolomite for aggregate and roadstone increased 8 percent in quantity and 13 percent in value. Beginning with 1968, a more detailed breakdown of material sold and used for this purpose is shown on table 15.

Production of agricultural limestone decreased 27 percent in quantity and 20 percent in value from that of 1967. Other uses for crushed and broken limestone and dolomite included railroad ballast, riprap, filler material, flux, poultry grit, and mineral food. Nearly 87 percent of Minnesota's 1968 limestone and dolomite output was transported by truck; the remainder was shipped by rail and river barge.

Output of dimension limestone and dolomite decreased 6 percent in quantity and 2 percent in value from that of 1967 chiefly because of a decrease in output sold for rough construction purposes. Sales of cut stone, sawed stone, house stone veneer, and other types of rough construction stone increased. Four companies operated quarries and plants in Blue Earth, Le Sueur, and Winona Counties.

Arrowhead Blacktop Co. produced 55,000 tons of crushed and broken basalt for bituminous aggregate from a deposit in St. Louis County.

Production of marl, used entirely for agricultural purposes, decreased in quantity and value. Output was reported from one pit in Wadena County.

New Ulm Quartzite Quarries, Inc., in Nicollet County and Jasper Stone Co., in Rock County produced crushed and broken quartzite. Total output increased 25 percent in quantity and value. Material was used for concrete aggregate and roadstone, filter stone, poultry grit, refractory stone, riprap, and other purposes.

Table 15.—Limestone and dolomite sold or used by producers, by uses

Use	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough architectural.....thousand cubic feet..	67	$315	33	$151
Other rough construction:				
Irregular-shaped stone.....thousand short tons..	-------	-------	1	5
Rubble.....do....	(1)	(1)	1	7
Dressed architectural:				
Cut.....thousand cubic feet..	90	1,315	97	1,352
House stone veneer.....do....	99	296	123	372
Sawed.....do....	8	49	11	59
Flagging.....do....	43	11	2	10
Total dimension.....approximate thousand short tons..	25	[2] 1,987	23	[2] 1,957
Crushed and broken:				
Concrete aggregate and roadstone:				
Concrete aggregate.....thousand short tons..	NA	NA	299	529
Bituminous aggregate.....do....	NA	NA	211	307
Macadam aggregates.....do....	NA	NA	198	299
Dense-graded road base stone.....do....	NA	NA	1,848	2,175
Surface treatment aggregates.....do....	NA	NA	673	805
Total aggregate and roadstone [2].....do....	2,968	3,647	3,229	4,116
Agricultural limestone.....do....	461	772	336	620
Railroad ballast.....do....	14	19	W	W
Riprap.....do....	104	136	48	62
Other [3].....do....	75	114	187	409
Total crushed and broken.....do....	3,622	4,688	3,800	5,207
Grand total.....do....	3,647	6,675	3,823	7,164

NA Not available.
W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Less than ½ unit.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes stone used for asphalt filler and other fillers or extenders; flux; poultry grit and mineral food; other uses; and item indicated by symbol W.

Sulfur.—Elemental sulfur was recovered as a byproduct at refineries operated by the Great Northern Oil Co. near Pine Bend, Dakota County, and Northwestern Refining Co. at St. Paul Park, Washington County. The Claus process was used to recover sulfur at the former location and the Modified-Claus process at the latter. Shipments increased in quantity and value over those of 1967.

Vermiculite.—Exfoliated vermiculite was produced from crude material mined outside the State at two plants in Minneapolis and one plant in St. Paul. The expanded material was used for various types of insulation, lightweight aggregate in plaster and concrete, agricultural purposes, and other uses. Sales increased 8 percent in quantity and 4 percent in value over those of 1967.

MINERAL FUELS

Peat.—Due mainly to unfavorable weather conditions, output of peat was less than half that of 1967. Peat was produced by seven companies, in Aitkin, Becker, Carlton, Itasca, Pine, and St. Louis Counties. Production consisted mainly of moss and reed-sedge peats. A small amount of humus peat was produced in Pine County. About three-fourths of the value of Minnesota's 1968 peat sales were in packaged form; the remainder was sold in bulk. Material was used for general soil improvement, packaging plants, and as an ingredient in potting soils.

Table 16.—Stone production, by counties

(Thousand short tons and thousand dollars)

County	1967		1968		Kind of stone produced in 1968 [1]
	Quantity	Value	Quantity	Value	
Big Stone	2	W	76	$623	Granite.
Blue Earth	258	$1,191	252	969	Limestone.
Cass	W	W	--------	--------	
Dakota	W	W	352	467	Limestone.
Dodge	W	W	182	207	Do.
Fillmore	383	443	337	522	Do.
Goodhue	285	326	199	225	Do.
Houston	205	220	288	W	Do.
Kanabec	--------	--------	(2)	W	Granite.
Lac qui Parle	3	W	2	441	Do.
Le Sueur	28	724	W	W	Limestone.
Mille Lacs	W	W	1	W	Granite.
Mower	252	344	410	552	Limestone.
Nicollet	W	W	W	W	Quartzite.
Olmsted	487	558	582	684	Limestone.
Redwood	W	W	1	44	Granite.
Renville	W	W	1	W	Do.
Rice	W	W	23	26	Limestone.
Rock	W	W	W	W	Quartzite.
St. Louis	65	95	55	W	Basalt.
Scott	370	611	346	798	Limestone.
Stearns	228	W	289	3,772	Granite.
Steele	W	W	W	W	Limestone.
Wabasha	126	W	181	194	Do.
Wadena	W	W	4	3	Marl.
Washington	W	W	544	W	Limestone.
Winona	W	W	43	478	Do.
Yellow Medicine	W	W	74	102	Granite.
Undistributed	1,466	6,929	185	2,939	
Total [3]	4,160	11,442	4,427	13,045	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] "Limestone" used generally to include dolomite.

[2] Less than ½ unit.

[3] Data may not add to totals shown because of independent rounding.

Table 17.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasive stone—Grinding pebbles and tube-mill liners:			
Jasper Stone Co	Box 206 Sioux City, Iowa 51102	Quarry and processing plant.	Rock.
Cement:			
Universal Atlas Cement Division, United States Steel Corp.	Chatham Center, Box 2969 Pittsburgh, Pa. 15230	Portland and masonry, wet process.	St. Louis.
Clays and shale:			
North Central Lightweight Aggregate Co., Inc.	4901 West Medicine Lake Dr. Minneapolis, Minn. 55427	Pit and plant	Hennepin.
Ochs Brick & Tile Co	Springfield, Minn. 56087	Pits and plant	Brown and Redwood.
Red Wing Sewer Pipe Corp	Red Wing, Minn. 55066	Processed stockpiled material.	Goodhue.
Twin City Brick Co	790 Joy Ave. St. Paul, Minn. 55118	Pit and plant	Ramsey.
Coke:			
American Steel & Wire Division, United States Steel Corp.	Morgan Park Duluth, Minn. 55800	Coke ovens	St. Louis.
Koppers Co., Inc	1000 Hamline Ave. North St. Paul, Minn. 55104	----do	Ramsey.
Iron ore:			
Cleveland-Cliffs Iron Co.:	1460 Union Commerce Bldg. Cleveland, Ohio 44115		
Canisteo		Mine and concentrator	Itasca.
Hawkins		Stockpile shipments	Do.
Hill-Trumbull		Mine and concentrator	Do.
Holman-Cliffs		Stockpile shipments	Do.
Sally		----do	Do.
Coons Pacific Co.:	2521 1st Ave. Hibbing, Minn. 55746		
Coons Pacific Plant		Concentrator	St. Louis.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Iron ore—Continued			
The Hanna Mining Co.:	100 Erieview Plaza Cleveland, Ohio 44114		
Rabbit Lake		Mine and concentrator	Crow Wing.
Spring Valley		Stockpile shipments	Fillmore.
Butler Taconite Project		Mine, concentrator, agglomerator.	Itasca.
Harrison and Patrick Groups.		Stockpile shipments	Do.
Mississippi Group		do	Do.
National Steel Pellet Project.		Mine, concentrator, agglomerator.	Itasca and St. Louis.
Douglas Group		Stockpile shipments	St. Louis.
East Alpena Mine		Mine	Do.
Pierce Group		Mine and concentrator	Do.
South Agnew Group		do	Do.
Inland Steel Co.:	80 West Monroe St. Chicago, Ill. 60603		
Armour No. 2		Stockpile shipments	Crow Wing.
Jones & Laughlin Steel Corp., Minnesota Ore Division:	Virginia, Minn. 55792		
Hill Annex		Mine and concentrators	Itasca.
Lind-Greenway		Mine and concentrator	Do.
McKinley		do	St. Louis.
Schley Group		do	Do.
Oglebay Norton Co.:	Hanna Bldg. Cleveland, Ohio 44115		
Thunderbird Mine		Mine; ore treated at Fairlane Plant.	Do.
Fairlane Plant		Concentrator and agglomerator.	Do.
Pacific Isle Mining Co.:	Box 157 Coleraine, Minn. 55722		
West Hill		Mine and concentrator	Itasca.
Higgins No. 2		Stockpile shipments	St. Louis.
Oneida		do	Do.
Pickands Mather & Co.:	2000 Union Commerce Bldg. Cleveland, Ohio 44115		
Danube		Mine and concentrator	Itasca.
Erie Commercial		Mine, concentrator, agglomerator.	St. Louis.
Mahoning		Mine and concentrator	Do.
Pittsburgh Pacific Co.:	2521 1st Ave. Hibbing, Minn. 55746		
Sagamore		Stockpile shipments	Crow Wing.
Arne Mine		do	St. Louis.
Coons		do	Do.
Dormer LOSP and Wade LOSP.		do	Do.
Julia Plant		Concentrator	Do.
Kerr W. Lease and Uno Dale.		Ore treated at Coons Pacific plant.	Do.
Lamberton and Lamberton Annex.		do	Do.
Leonidas		do	Do.
Lincoln		Stockpile shipments	Do.
McEwen-Onondaga Mine.		Mine	Do.
Monroe		Ore treated at Coons Pacific plant.	Do.
Nelson LOSP		do	Do.
Syracuse		Stockpile shipments	Do.
Wyoming Annex		do	Do.
Reserve Mining Co.:	Silver Bay, Minn. 55614		
Peter Mitchell		Mine and primary crushing.	Do.
E. W. Davis Works		Concentrator and agglomerator.	Lake.
Rhude & Fryberger:	Box 66 Hibbing, Minn. 55746		
Gross-Nelson		Mine and concentrator	St. Louis.
Hull-Rust Group		do	Do.
Schroeder Mining Co.:	Box 576 Chatfield, Minn. 55923		
Wright		do	Fillmore.
Snyder Mining Co.:	Box 1106 Pittsburgh, Pa. 15230		
Kosmerl lease area, Wanless, Whiteside, and Woodbridge.		Mines	St. Louis.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Iron ore—Continued			
United States Steel Corp., Minnesota Ore Operations:	Box 417 Mountain Iron, Minn. 55768		
Plummer Group		Mine and concentrator	Itasca.
Trout Lake Concentrator.		Concentrator	Do.
Kosmerl		Mined by Snyder Mining Co. in conjunction with Whiteside Mine.	St. Louis.
Minntac		Mine, concentrator, agglomerator.	Do.
Rouchleau Group		Mine and concentrator	Do.
Sherman Group		do	Do.
Stephens Mine		Mine	Do.
Iron and steel:			
American Steel & Wire Division, United States Steel Corp.	Morgan Park Duluth, Minn. 55800	Iron blast furnace and open-hearth steel furnaces.	Do.
North Star Steel Co	1400 Red Rock Rd. St. Paul, Minn. 55119	Electric steel furnace	Ramsey.
Secondary lead smelters:			
Gopher Smelting & Refining Co.	Hwy. 49 and Hwy. 55 St. Paul, Minn. 55111	Processing plant	Dakota.
National Lead Co	3650 Hampshire Ave. South Minneapolis, Minn. 55426	do	Hennepin.
Lime:			
American Crystal Sugar Co	Boston Bldg. Denver, Colo. 80201	Quicklime and shaft kilns.	Carver, Clay, Polk.
Cutler-Magner Co	1116 Fidelity Bldg. Duluth, Minn. 55802	Quicklime and hydrated lime, 1 rotary kiln.	St. Louis.
Manganiferous ore:			
The Hanna Mining Co.:	100 Erieview Plaza Cleveland, Ohio 44114		
Algoma		Stockpile shipments	Crow Wing.
Lauretta		Development only	Do.
Pittsburgh Pacific Co.:	2521 1st Ave. Hibbing, Minn. 55746		
Louise Mine		Mine and concentrator	Do.
Mangan No. 1, Sagamore, and Sultana.		Stockpile shipments	Do.
Peat:			
Colby Pioneer Peat Co	Box 8 Hanlontown, Iowa 50444	Peat bog	Aitkin.
Northland Products Co., Inc	Box 16 Fergus Falls, Minn. 56537	do	Becker.
Power-O-Peat Co	Gilbert, Minn. 55741	do	St. Louis.
Red Wing Peat Corp	Cromwell, Minn. 55726	do	Carlton.
Expanded perlite:			
Zonolite Division, W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 01109	Processing plant	Hennepin.
Sand and gravel:			
Anderson Aggregates, Inc	100 North Seventh St. Minneapolis, Minn. 55403	Pit; 1 stationary, 2 portable plants.	Hennepin.
Commercial Aggregates, Inc. (Barton Contracting Co.)	10300 89th Ave. North Osseo, Minn. 55369	Pits and stationary plants.	Hennepin, Washington, Wright.
Duininck Bros. & Gilchrist	Olivia, Minn. 56277	Pits and portable plants.	Becker, Clearwater, Goodhue, Kandiyohi, McLeod, Meeker, Redwood, Renville, Sibley, Stearns, Yellow Medicine.
Fischer Construction Co., Inc.	Rosemount, Minn. 55068	do	Carver, Clearwater, Crow Wing, Dakota, Freeborn, Hennepin, Mille Lacs, Nobles, Otter Tail, Ramsey, St. Louis, Sherburne, Waseca, Wright.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Gopher State Silica, Inc.	Le Sueur, Minn. 56058	Pit and stationary plant.	Le Sueur.
McLaughlin & Schulz, Inc.	Box 201 Marshall, Minn. 56258	Pits and portable plants.	Cottonwood, Douglas, Lincoln, Lyon, Marshall, Polk, Pope, Redwood, Traverse.
Mark Sand & Gravel Co.	Fergus Falls, Minn. 56537	do	Douglas, Grant, Norman, Otter Tail, Polk, Stearns.
Megarry Brothers, Inc.	437 33d Ave. North St. Cloud, Minn. 56301	do	Beltrami, Cook, Sherburne, Stearns.
Minnesota Valley Improvement Co.	Granite Falls, Minn. 56241	do	Carlton, Douglas, Grant, Hennepin, McLeod, Otter Tail, Stearns, Todd, Yellow Medicine.
J. L. Shiely Co.	1101 North Snelling Ave. St. Paul, Minn. 55108	Pit and stationary plant.	Washington.
Ulland Brothers, Inc.	Box 98 Austin, Minn. 55912	Pits and portable plants.	Freeborn, Mower, Olmsted, Steele.
Do	Box 340 Cloquet, Minn. 55720	do	Carlton, Lake, St. Louis.
Stone:			
Basalt:			
Arrowhead Blacktop Co.	14th Ave. West & Waterfront Duluth, Minn. 558[illegible]	Quarry and stationary plant.	St. Louis.
Granite:			
Cold Spring Granite Co.	Cold Spring, Minn. 56320	Quarries	Big Stone, Kanabec, Lac qui Parle, Mille Lacs, Renville.
Do	do	Quarries and stationary plant.	Stearns.
Delano Granite, Inc.	Delano, Minn. 55328	Quarries	Big Stone and Stearns.
Do	do	Stationary plant	Wright.
The Green Co.	Granite Falls, Minn. 56241	Quarry and stationary plant.	Yellow Medicine.
Shiely-Petters Crushed Stone Co., Inc.	Box 69 St. Cloud, Minn. 56301	do	Stearns.
Limestone and dolomite:			
The Babcock Co.	Kasota, Minn. 56050	do	Le Sueur.
Biesanz Stone Co., Inc.	116 West 7th St. Winona, Minn. 55987	do	Winona.
Bryan Rock Products, Inc.	Box 215 Shakopee, Minn. 55379	Quarries; stationary and portable plants.	Scott and Washington.
Kappers Construction Co., Inc.	600 Lyndale Ave. Spring Valley, Minn. 55975	do	Fillmore and Mower.
Edward Kraemer & Sons, Inc.	Plain, Wis. 53577	Quarry and portable plant.	Dakota.
Mankato Stone Co.	826 North Front St. Mankato, Minn. 56001	Quarry and stationary plant.	Blue Earth.
Osmundson Brothers	Adams, Minn. 55909	Quarry and portable plant.	Mower.
Patterson Quarries, Inc., Division of Mathy Const. Co.	St. Charles, Minn. 55972	Quarries and portable plants.	Olmsted and Wabasha.
Quarve & Anderson Co.	Route 3, Box 27 Rochester, Minn. 55901	do	Dodge, Goodhue, Olmsted, Wabasha, Winona.
J. L. Shiely Co.	1101 North Snelling Ave. St. Paul, Minn. 55108	Quarries and stationary plants.	Scott and Washington.
Vetter Stone Co.	Route 4 Mankato, Minn. 56001	Quarries and stationary plant.	Blue Earth and Le Sueur.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Marl:			
Richard Nanik Marl Pit	Star Route Staples, Minn. 56479	Pit	Wadena.
Quartzite:			
Jasper Stone Co	Box 206 Sioux City, Iowa 51102	Quarry and stationary plant.	Rock.
New Ulm Quartzite Quarries, Inc.	New Ulm, Minn. 56073	do	Nicollet.
Recovered sulfur:			
Great Northern Oil Co	Box 3596 St. Paul, Minn. 45101	Elemental sulfur recovered as a byproduct of oil refining.	Dakota.
Northwestern Refining Co	P.O. Drawer 9 St. Paul, Minn. 55101	do	Washington.
Exfoliated vermiculite:			
MacArthur Co	936 Raymond Ave. St. Paul Park, Minn. 55114	Processing plant	Ramsey.
The B. F. Nelson Manufacturing Co.	401 Main St. NE Minneapolis, Minn. 55413	do	Hennepin.
Zonolite Division, W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 01109	do	Do.

The Mineral Industry of Mississippi

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Mississippi Geological, Economic, and Topographical Survey for collecting information on all minerals except fuels.

By S. O. Wood, Jr [1] and William H. Moore [2]

Value of Mississippi mineral production increased 2.0 percent to $221 million, the highest value ever attained. Mineral fuels—petroleum, natural gas, and natural gas liquids—represented 85.6 percent of the total value. Mineral fuels accounted for a $7 million increase in production value over that of 1967 whereas production value of other minerals decreased about $3 million.

Table 1.—Mineral production in Mississippi[1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Clays .... thousand short tons..	1,654	$7,852	1,698	$9,075
Natural gas .... million cubic feet..	139,497	24,138	135,051	22,601
Natural gas liquids:				
Natural gasoline and cycle products thousand 42-gallon barrels..	427	1,167	459	1,277
LP gases .... do....	424	1,085	518	958
Petroleum (crude) .... do....	57,147	155,726	58,708	164,396
Sand and gravel .... thousand short tons..	14,039	15,485	11,980	12,669
Stone (includes shell, 1967) .... do....	1,879	2,055	747	833
Value of items that cannot be disclosed: Cement, iron ore (1967), lime, and magnesia	XX	[r] 9,055	XX	9,146
Total	XX	[r] 216,558	XX	220,955
Total 1957–59 constant dollars	XX	209,104	XX	[p] 211,688

[p] Preliminary. [r] Revised. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

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[1] Petroleum engineer, Dallas Office of Mineral Resources, Bureau of Mines, Dallas, Tex.

[2] Director, Mississippi Geological, Economic, and Topographical Survey, Jackson, Miss.

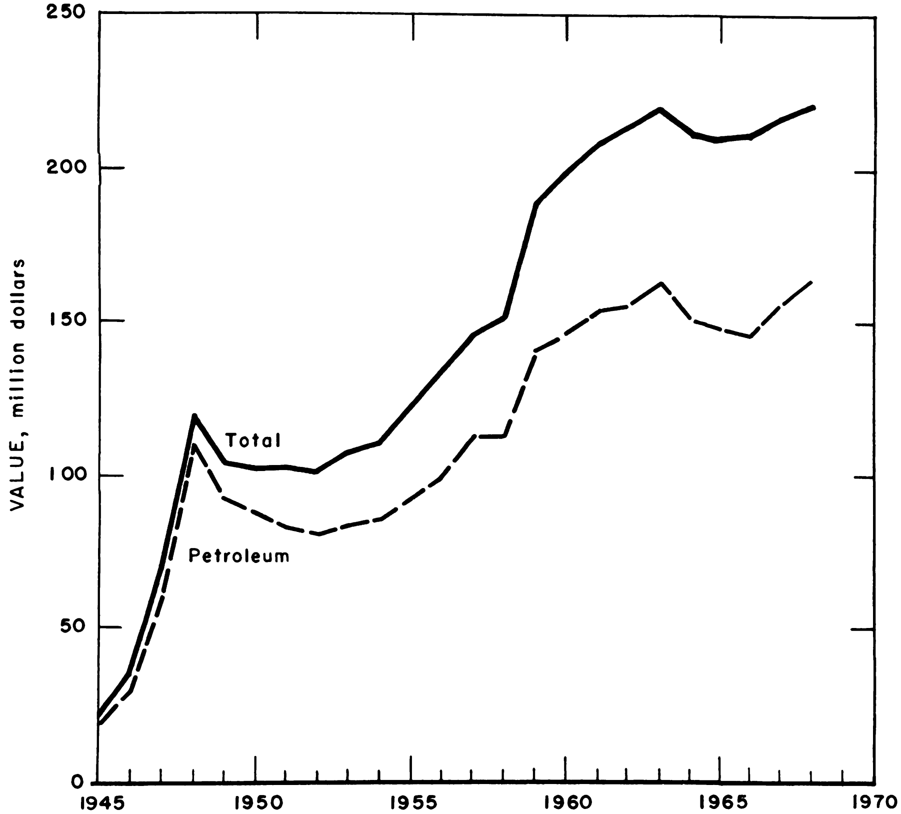

Figure 1.—Value of petroleum and total value of mineral production in Mississippi.

Table 2.—Value of mineral production in Mississippi, by counties[1]

(Thousands)

County	1967 r	1968	Minerals produced in 1968 in order of value
Adams	$24,018	$22,318	Petroleum, sand and gravel, natural gas, natural gas liquids.
Alcorn	W	W	Clays, sand and gravel.
Amite	3,029	2,245	Petroleum, natural gas, sand and gravel.
Attala	W	W	Clays.
Bolivar	67	144	Sand and gravel.
Carroll	W	678	Sand and gravel, clays.
Chickasaw	17	-------	
Claiborne	5	6	Sand and gravel.
Clarke	7,371	11,958	Petroleum, natural gas.
Clay	564	531	Sand and gravel, stone, natural gas, petroleum.
Copiah	W	W	Sand and gravel.
Covington	1,283	1,413	Sand and gravel, petroleum, natural gas.
De Soto	W	W	Sand and gravel.
Forrest	6,218	4,193	Natural gas, sand and gravel, petroleum, natural gas liquids, clays.
Franklin	10,752	13,914	Petroleum, natural gas, sand and gravel.
Greene	211	340	Petroleum.
Hancock	252	262	Natural gas, sand and gravel, petroleum.

See footnotes at end of table.

Table 2.—Value of mineral production in Mississippi, by counties[1]—Continued

(Thousands)

County	1967[r]	1968	Minerals produced in 1968 in order of value
Harrison	W	$302	Sand and gravel.
Hinds	$3,632	3,526	Petroleum, sand and gravel, clays, natural gas.
Holmes	W	W	Sand and gravel.
Itawamba	W	W	Clays, natural gas.
Jackson	W	W	Magnesia, lime, sand and gravel.
Jasper	25,909	25,917	Petroleum, natural gas, natural gas liquids, sand and gravel.
Jefferson	2,087	1,557	Petroleum, natural gas, sand and gravel.
Jefferson Davis	4,974	5,621	Natural gas, petroleum.
Jones	12,551	11,595	Petroleum, natural gas, natural gas liquids, clays.
Kemper	19	-------	
Lafayette	18	19	Sand and gravel.
Lamar	11,364	13,759	Petroleum, natural gas.
Lauderdale	41	40	Clays, sand and gravel.
Lawrence	54	-------	
Lee	W	W	Clays.
Leflore	55	-------	
Lincoln	7,704	6,978	Petroleum, natural gas, natural gas liquids, sand and gravel.
Lowndes	585	481	Sand and gravel, clays.
Madison	1,884	2,051	Petroleum, natural gas, sand and gravel, natural gas liquids.
Marion	9,187	7,391	Natural gas, petroleum, sand and gravel, natural gas liquids.
Marshall	402	409	Clays.
Monroe	2,693	2,774	Clays, sand and gravel, natural gas, petroleum.
Noxubee	589	557	Sand and gravel, clays.
Oktibbeha	26	-------	
Panola	W	W	Clays, sand and gravel.
Pearl River	1,848	1,032	Natural gas, petroleum, sand and gravel, clays.
Perry	W	W	Sand and gravel, petroleum.
Pike	11,732	6,971	Petroleum, natural gas liquids, sand and gravel, natural gas.
Pontotoc	W	15	Sand and gravel, clays.
Prentiss	W	9	Clays.
Rankin	5,200	5,915	Cement, petroleum, stone, natural gas, sand and gravel.
Scott	139	137	Petroleum, natural gas.
Simpson	2,865	3,650	Petroleum, natural gas, sand and gravel.
Smith	9,807	16,680	Petroleum, natural gas, natural gas liquids, clays, stone.
Stone	246	269	Sand and gravel.
Sunflower	W	21	Clays.
Tate	64	90	Sand and gravel.
Tippah	W	W	Clays.
Tishomingo	W	W	Sand and gravel.
Tunica	36	-------	
Union	615	613	Sand and gravel.
Walthall	5,165	4,166	Natural gas, petroleum.
Warren	W	W	Cement, sand and gravel.
Washington	W	W	Sand and gravel.
Wayne	8,417	9,797	Petroleum, natural gas, sand and gravel.
Wilkinson	6,849	7,198	Petroleum, natural gas.
Winston	W	W	Clays.
Yalobusha	W	240	Sand and gravel.
Yazoo	7,510	7,787	Petroleum, sand and gravel, natural gas.
Undistributed	18,504	15,386	
Total	216,558	220,955	

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[r] Revised.

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties were not listed because no production was reported: Benton, Calhoun, Choctaw, Coahoma, George, Grenada, Humphreys, Issaquena, Leake, Montgomery, Neshoba, Newton, Quitman, Sharkey, Tallahatchie, and Webster.

Table 3.—Indicators of Mississippi business activity

	1967	p 1968	Change (percent)
Employment and labor force, annual average:			
Total labor force (nonagricultural)....thousands..	541.3	553.8	+2.3
Unemployment....do....	8.1	7.3	−9.9
Employment:			
Construction....do....	31.2	31.0	−.6
Mining....do....	5.6	5.8	+3.6
All manufacturing....do....	167.1	172.4	+3.2
All industries [1]....do....	533.2	546.5	+2.5
Factory payrolls....millions..	$719.7	$818.3	+13.7
Personal income:			
Total....do....	$4,453	$4,821	+8.3
Per capita....	$1,900	$2,057	+8.3
Construction activity:			
Building permits, total private nonresidential....millions..	$41.6	$45.2	+8.7
Cement shipments to and within Mississippi thousand 376-pound barrels..	4,224	4,371	+3.5
Farm marketing receipts....millions..	$780.9	$794.2	+1.7
Mineral production....do....	r $216.6	$221.0	+2.0

r Revised.

p Preliminary.

[1] Transportation and public utilities; wholesale and retail trade; finance, insurance, and real estate; services; and government included.

Sources: Survey of Current Business, Construction Review, The Farm Income Situation, Employment and Earnings and Monthly Report on the Labor Force, and Bureau of Mines.

Mississippi Power and Light Co. started installation of a 750,000-kilowatt steam-generating unit at its Baxter Wilson Steam Electric station near Vicksburg. The new unit, expected to be in operation by late 1971, will increase station capability to 1,300,000 kilowatts. South Mississippi Electric Power Association began erection of a $23 million electricity generating plant near Moselle in Jones County. Plant design includes three 60,000-kilowatt steam-driven generators. At maximum generating capacity of 180,000 kilowatts, natural gas fuel consumption is expected to be from 40 to 45 million cubic feet daily.

Employment.—According to the Mississippi Employment Security Commission, overall average mineral industry employment increased slightly after showing no gain in 1967. The gain was associated with increased exploration for oil and gas. A decrease was experienced in the mining of other minerals, principally because sand and gravel activities declined. Overall mineral industry employment continued to constitute 1.1 percent of the nonagricultural labor force.

Transportation.—Colonial Pipeline started operations to increase the capacity

Table 4.—Wage and salaried workers in petroleum production, refining, and related industries

Year	Crude petroleum and natural gas production	Petroleum refining [1]	Pipeline transportation (except natural gas)	Gas utilities	Retail filling stations	Chemicals manufactured as byproducts of petroleum or used in refining of petroleum [2]
1964....	5,300	700	150	2,300	5,250	300
1965....	4,800	710	155	2,290	5,300	380
1966....	4,700	750	100	2,300	5,300	410
1967....	4,904	827	151	2,193	5,100	373
1968....	5,482	862	151	2,164	5,144	393

[1] Employment in petroleum refineries and petrochemicals manufactured in petroleum refineries.

[2] Employment in petrochemical manufacturing facilities located outside petroleum refineries.

Source: Mississippi Employment Security Commission.

Table 5.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Metal	8	271	1	6	-------	-------	-------	-------
Nonmetal	918	260	287	1,905	1	48	25.72	8,954
Sand and gravel	444	262	116	1,140	-------	24	21.05	412
Stone	253	248	68	511	-------	7	18.69	2,098
Total [1]	1,618	259	417	3,563	1	79	22.45	2,547
1968: [p]								
Nonmetal	795	251	200	1,610	-------	28	17.39	627
Sand and gravel	360	247	88	836	-------	16	19.14	4,059
Stone	185	243	45	365	-------	2	5.48	107
Total	1,340	249	333	2,811	-------	46	16.87	1,580

[p] Preliminary.

[1] Data may not add to totals shown because of independent rounding.

of its 30- and 36-inch line from Houston, Tex., to Linden, N.J. A 5,000-horsepower pumping unit is to be installed at each of 24 pump stations, including the Mississippi stations at McComb and Meridian.

Capline, the largest diameter (40-inch) pipeline in the Western Hemisphere, that extends from St. Mary, La., to Patoka, Ill., was placed in service. The 630-mile line traverses the western portion of Mississippi in a north-south direction. There are three pump stations in the State: Sardis, Jackson, and Liberty. Facilities have been provided at the Liberty station whereby crude oil produced in Mississippi can enter the line.

The Federal Power Commission authorized the Mississippi River Transmission Co. to install about 195 miles of 26-inch mainline between Perryville, La., and St. Louis, Mo. The line will increase the company's transmission capability by about 100 million cubic feet of gas daily.

Standard Oil Co. of California filed an application with the Federal Power Commission to install a pipeline from the Main Pass area in Louisiana to Pascagoula, Miss.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The combined value of natural gas, natural gas liquids, and crude petroleum production increased by $7 million, or 3.9 percent from 1967. The combined value of $189 million was 85.6 percent of the total value of mineral production, compared with 84.0 percent in 1967.

Mississippi continued to rank ninth as an oil-producing State. The leading petroleum producing counties in descending order were Jasper, Adams, Smith, Franklin, Lamar, Clarke, and Jones.

Total drilling activity resulted in the completion of 709 wells: 169 oil productive; 15 gas productive, including one well completed to produce carbon dioxide gas; and 525 dry holes. Drilling activity decreased 3.9 percent from the 1967 rate, slightly less than the decline in drilling experienced nationwide. Average depth of wells drilled in Mississippi was about 7,660 feet, considerably deeper than the national average of approximately 4,500 feet.

There were 18 new oilfields discovered; 13 of the discoveries were productive from the Wilcox Formation and five discoveries were productive from the Smackover Formation. Wilcox discoveries were West Fairchild's Creek, Ivanhoe, and Coles Creek in Adams County; Mount Nebo Lake in Amite County; Byrd, East County Lake, Tally's Creek, South Tom Branch, and Corbin Branch in Franklin County; and Artonish, Kings Branch, Dunbar Creek, and Pond in Wilkinson County. Smackover discoveries were Harmony, East Nancy, Pachuta Creek, and Double Creek in Clarke County; and South Cypress Creek in Wayne County.

Table 6.—Oil and gas well drilling in 1968, by counties

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Adams	34	-----	33	3	-----	99	169
Amite	-----	-----	-----	1	-----	14	15
Bolivar	-----	-----	-----	-----	-----	1	1
Claiborne	-----	-----	-----	-----	-----	2	2
Clarke	16	-----	12	4	-----	13	45
Forrest	-----	-----	-----	-----	-----	1	1
Franklin	31	-----	39	5	-----	85	160
Greene	1	-----	-----	-----	-----	1	2
Hinds	-----	-----	-----	-----	-----	1	1
Hancock	-----	-----	1	-----	-----	-----	1
Itawamba	-----	-----	-----	-----	-----	1	1
Jackson	-----	-----	-----	-----	-----	1	1
Jasper	5	-----	3	-----	-----	5	13
Jefferson	3	-----	8	-----	-----	24	35
Jefferson Davis	-----	7	3	-----	-----	-----	10
Jones	3	-----	1	-----	-----	3	7
Lawrence	-----	-----	-----	-----	-----	1	1
Lamar	3	-----	1	-----	-----	-----	4
Lincoln	2	-----	-----	-----	-----	-----	2
Lowndes	-----	-----	-----	-----	-----	1	1
Madison	1	-----	1	-----	-----	8	10
Marion	-----	2	1	-----	-----	-----	3
Monroe	-----	-----	-----	-----	-----	1	1
Pearl River	1	2	-----	-----	-----	-----	3
Pike	2	-----	2	-----	-----	1	5
Rankin	2	1	2	-----	[1] 1	6	12
Scott	-----	-----	-----	-----	-----	2	2
Simpson	1	1	2	-----	-----	1	5
Smith	10	-----	4	-----	-----	9	23
Walthall	-----	1	-----	-----	-----	1	2
Warren	-----	-----	-----	-----	-----	1	1
Wayne	9	-----	3	1	-----	10	23
Wilkinson	23	-----	23	4	-----	75	125
Yazoo	4	-----	1	-----	-----	12	17
Total:							
1968	151	14	145	18	1	380	709
1967	208	16	179	22	-----	313	738

[1] Produces carbon dioxide.

Source: Mississippi State Oil and Gas Board monthly bulletin.

The Mississippi Geological, Economic, and Topographical Survey published a report on the Jurassic stratigraphy of Mississippi.[3]

According to the Mississippi State Oil and Gas monthly bulletin as of December 31, 1968, the State had 361 oil pools and 55 gas pools producing in 342 fields. There were 3,556 producible wells, about 4.0 percent fewer than the comparable 3,706 in 1967.

Natural Gas.—Four counties—Jefferson Davis, Marion, Walthall, and Forrest—supplied 66 percent of the State's natural gas production. Natural gas reserves continued the downward trend that started in 1961. According to the American Gas Association, Inc., the reserves of 1,434 billion cubic feet at the end of 1968 were approximately half of the 1961 reserves. The reserve-to-production ratio declined from 16.4:1 in 1961 to 8.8:1 in 1968. One exploratory well discovered gas. General Crude Oil Co. completed its No. 1 J. A.

Table 7.—Marketed production of natural gas[1]

Year	Million cubic feet	Value (thousands)
1964	180,428	$31,385
1965	166,825	28,861
1966	156,652	27,257
1967	139,497	24,138
1968	135,051	22,601

[1] Comprises gas either sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in gas pipelines.

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[3] Dinkins, Theo H., Jr., Marvin L. Oxley, Edward Minihan, and Julius M. Ridgeway. Jurassic Stratigraphy of Mississippi. Mississippi Geol., Econ., and Topographical Survey Bull. 109, 1968, 77 pp.

Spann Estate well in Rankin County to produce carbon dioxide gas from the Smackover Formation.

Mississippi Valley Gas Co. had a storage capacity of 1,150 million cubic feet of gas in the Amory field of Monroe County. United Gas Pipe Line Co. controlled 5,816 million cubic feet of storage capacity in formations of the Jackson Dome in Rankin and Hinds Counties. Of the total 6,966 million cubic feet storage capacity in the State, 5,738 million cubic feet constituted the working capacity.

Natural Gas Liquids.—Reserves of natural gas liquids in Mississippi increased 2,266,000 barrels, the largest increase since 1954, according to the American Gas Association, Inc. The State reserve was 0.2 percent of the national reserves. The ratio of reserves to yearly production in 1968 remained virtually unchanged at 20:1.

Table 8.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves, Dec. 31, 1967	Changes in proved reserves, due to extensions and discoveries in [1] 1968	Proved reserves, Dec. 31, 1968	Change in proved reserves from 1967 (percent)
Crude oil____________thousand barrels__	356,686	20,332	325,649	—9
Natural gas liquids [2]____________do____	17,312	2,073	19,578	+13
Natural gas_________million cubic feet__	1,597,007	13,462	1,434,078	—10

[1] Excludes revisions.

[2] Includes condensate, natural gasoline, and LP gases.

Sources: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association, Proved Reserves of Crude Oil, Natural Gas Liquids and Natural Gas published in the Tulsa Daily World, 64th yr., No. 206, Apr. 7, 1969, p. 10.

Table 9.—Natural gas liquids production

(Thousand 42-gallon barrels and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1964________________________________	654	$1,644	554	$780	1,208	$2,424
1965________________________________	633	1,606	527	975	1,160	2,581
1966________________________________	566	1,483	443	987	1,009	2,470
1967________________________________	427	1,167	424	1,085	851	2,252
1968________________________________	459	1,277	518	958	977	2,235

At yearend total capacity of natural gas processing and cycling plants in Mississippi was 294 million cubic feet per day, a 3-percent decrease from 1967. Statewide, the average gas throughput was 66 percent of capacity. Southwest Gas Producing Co. and Placid Oil Co. jointly constructed a small gas processing plant in the East Nancy field, Clarke County. The plant was designed to use the refrigeration method and process about 1.5 million cubic feet of gas daily.

Petal salt dome, Forrest County, is the only underground storage site for liquefied petroleum (LP) gases. According to The Oil and Gas Journal, underground storage as of October 1968 was as follows: Propane, 3,767,000 barrels; butane, 600,000 barrels; and LP gases, 2,240,000 barrels.

Petroleum.—Crude oil production was obtained from 30 counties in 1968. Thirteen counties had production of more than 1 million barrels and accounted for 91 percent of total production in the State. The top seven counties in descending order of production—Jasper, Adams, Smith, Franklin, Lamar, Clarke, and Jones—accounted for 67 percent of total production.

Table 10.—Crude petroleum production

(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value
1964	56,777	$151,595
1965	56,183	148,437
1966	55,227	146,353
1967	57,147	155,726
1968	58,708	164,396

An average of 3 barrels of salt water per barrel of crude oil was produced in 1968. An increase in water production accompanied decreases in oil production from many of the older fields. This was especially noticeable for fields having predominantly water-drive energy mechanisms, such as the Wilcox fields in the southwestern part of the State.

Table 11.—Crude petroleum production, indicated demand, and stocks in 1968, by month

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Mississippi	Month	Production	Indicated demand	Stocks originating in Mississippi
January	4,858	4,896	2,281	September	4,857	4,895	4,078
February	4,607	4,277	2,611	October	5,038	4,000	5,116
March	4,961	4,626	2,946	November	4,883	5,684	4,315
April	4,754	5,025	2,675	December	5,097	4,207	5,205
May	4,958	4,758	2,875				
June	4,783	4,909	2,749	Total:			
July	4,936	3,791	3,894	1968	58,708	55,822	XX
August	4,976	4,754	4,116	1967	57,147	57,569	XX

XX Not applicable.

Table 12.—Crude petroleum produced by fields[1]

(Thousand 42-gallon barrels)

Field	1964	1965	1966	1967	1968
Baxterville	5,822	5,592	5,399	5,027	5,025
Bay Springs	--------	970	3,487	3,931	3,680
Brookhaven	1,456	1,299	1,078	(2)	(2)
Bryan	1,773	1,312	1,125	(2)	(2)
Eucutta	1,232	1,050	814	(2)	(2)
Heidelberg	3,491	3,904	3,830	3,891	3,822
Lagrange, N & S	1,236	1,245	950	(2)	(2)
Little Creek	5,589	4,137	2,841	1,976	1,229
McComb	4,379	3,837	2,797	1,760	1,082
Quitman Bayou	(2)	(2)	1,392	2,852	2,515
Raleigh	1,511	1,304	1,191	1,124	1,081
Smithdale	1,019	1,155	950	(2)	(2)
Soso	2,380	2,070	1,939	2,129	2,002
Summerland	(2)	1,096	1,291	1,589	1,275
Tallahala Creek	--------	--------	--------	--------	1,983
Tinsley	2,650	2,447	2,325	2,293	2,188
Yellow Creek, N & W	1,276	1,191	1,027	(2)	(2)
Other fields[3]	22,963	23,574	22,796	30,575	32,831
Total	56,777	56,183	55,227	57,147	58,708

[1] Based on The Oil and Gas Journal data adjusted to Bureau of Mines total.
[2] Included with "Other fields."
[3] Bureau of Mines data.

The drilling of 399 exploratory wells resulted in the discovery of 18 oilfields, an oil discovery ratio of 1 out of 22. As in previous years, most of the exploratory drilling was to test the Wilcox horizon. Of the 308 Wilcox exploratory wells, 13 were oil producers for a success ratio of 1 out of 24. The Jurassic exploration activities that began accelerating in 1965 continued. A total of 41 exploratory wells drilled to test Jurassic horizons resulted in the discovery of five oilfields and one carbon dioxide gasfield. One of the larger discoveries was the Pachuta Creek field in Clarke County. This field was discovered with the completion of the Robert Mosbacher et al No. 1 Hugh H. Moore et al to produce oil from the Jurassic (Smackover Formation) at depths from 12,990 to 13,034 feet. Initial daily production on March 23, 1968, was 606 barrels of 35° API gravity crude oil and 75 barrels of wâter. The field is being developed on 80-acre spacing. By the end of 1968 eight wells (11 completions) were in the field—one well was a triple completion and one well was a dual completion. At yearend, daily oil production rate from Pachuta Creek field was about 3,000 barrels.

Again, as in 1967, there was considerable emphasis on developmental drilling in Jurassic fields. Of 54 developmental wells drilled in Jurassic fields, 30 resulted in oil producers for a success ratio of about 3 out of 5. Three of the wells were multiple completions—one triple and two duals. Production from Jurassic fields helped to increase crude-oil production in the State to an alltime high.

According to the American Petroleum Institute (API) proved crude-oil reserves at yearend were 325.6 million barrels, a decrease of 31 million barrels from 1967. The decrease in reserves, coupled with the increase in production, resulted in a change in reserve-to-production ratio from 6.2:1 to 6.0:1. API also estimated that crude-oil productive capacity declined from 179,915 barrels per day at the end of 1967 to 173,000 barrels per day at the end of 1968.

The four refineries in Mississippi had a crude-oil processing capacity of 181,500 barrels per stream day and were operated at an average of 93.4 percent of capacity during 1968. No foreign oil was processed in Mississippi, and about 20 percent of the oil processed was produced in the State.

Oil produced from secondary-recovery operations continued to increase. From about 9 million barrels (16 percent of production) in 1967 there was an increase to 11.7 million barrels (20 percent of production) in 1968.

Petrochemicals.—First Chemical Corp., subsidiary of First Mississippi Corp., commenced operating its new aniline plant at Pascagoula. Plant capacity is more than 50 million pounds of aniline and related nitrated products including nitrobenzene, paranitrotoluene, orthonitrotoluene, and orthotoluidine. Facilities to upgrade aniline to diphenylamine were incorporated in the plant.

NONMETALS

Cement.—Shipments of portland cement increased 4.0 percent, and masonry cement increased 10.6 percent. The unit value of portland cement increased approximately 1 percent, whereas the unit value of masonry cement increased about 5 percent.

Clays.—The quantity of fuller's earth sold or used continued to increase. There also was a price increase of about 8 percent in 1968. Miscellaneous clay used for heavy clay products and lightweight aggregate decreased 2 percent and constituted 63 percent of the State's clay production. Fire clay and bentonite production increased 3 and 7 percent, respectively. Ball clay was produced in Panola County. International Minerals & Chemical Corp. is constructing a bentonite processing plant at Binford, approximately 4 miles southwest of Aberdeen. The plant is expected to process about 125,000 to 150,000 tons of bentonite per year.

Table 13.—Clays sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Bentonite		Ball clay, fire clay, and fuller's earth		Miscellaneous clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1964	270	$3,352	286	$2,003	775	$775	1,331	$6,130
1965	280	3,477	299	2,570	923	950	1,502	6,997
1966	291	3,615	280	2,673	1,156	1,201	1,727	7,489
1967	259	3,067	306	3,306	1,089	1,479	1,654	7,852
1968	277	3,128	353	4,525	1,063	1,422	1,693	9,075

Lime.—The quantity of lime sold or used increased 2.6 percent.

Magnesium Compounds.—Production of magnesium compounds, used in the manufacture of refractory bricks, decreased 13 percent.

Perlite.—Johns-Manville Products Corp. continued production of expanded perlite in Adams County.

Sand and Gravel.—Production was reported from 43 of the State's 82 counties. The leading producing counties in order of value were Copiah, Hinds, Forrest, Covington, and Carroll, which accounted for 41 percent of the tonnage and 42 percent of the value.

Table 14.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	7,479	$7,871	346	$698	7,825	$8,569
1965	7,192	7,785	1,255	932	8,447	8,717
1966	12,307	12,815	368	748	12,675	13,563
1967	13,575	14,299	464	1,186	14,039	15,485
1968	11,660	12,522	320	147	11,980	12,669

Table 15.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,021	$907	2,173	$2,002
Paving	3,349	3,311	1,844	1,750
Other [1]	218	299	239	331
Total	4,588	4,517	4,256	4,083
Gravel:				
Building	1,416	1,525	2,593	2,770
Paving	7,227	7,759	4,426	5,177
Railroad ballast	W	W	57	28
Other [2]	344	498	328	464
Total	8,987	9,782	7,404	8,439
Total sand and gravel	13,575	14,299	11,660	12,522
Government-and-contractor operations:				
Sand: Paving	305	763	--------	--------
Gravel: Paving	159	423	320	147
Total sand and gravel	464	1,186	320	147
Grand total	14,039	15,485	11,980	12,669

W Withheld to avoid disclosing individual company confidential data, included with "Other."

[1] Includes fill, industrial sand, and other construction sand.

[2] Includes railroad ballast (1967), fill, other construction gravel, and miscellaneous gravel.

Stone and Shell.—Operations to recover oyster and clam shell offshore from Harrison County were discontinued. A change in accounting procedures resulted in a much lower reported production of stone in 1968; however, on a comparable basis, there was no significant change in stone production from that of the previous year.

Sulfur.—Recovery of sulfur from refinery and natural gases was virtually unchanged in quantity from 1967 levels. Average unit price for sulfur produced in Mississippi increased about 21 percent. At yearend, Phillips Petroleum Co. and Pan American Sulphur Co. were drilling below 17,000 feet on their No. A–1 Flurry well, a confirmation test in the Black Creek hydrogen sulfide gas productive field. Contract depth for the test well is 20,000 feet, and location is about 2 miles south of the discovery well.

METALS

No production of metals was reported for Mississippi in 1968.

Table 16.—Principal producers

Commodity and company	Address	Type of activity	County
Cement: [1]			
Marquette Cement Manufacturing Co.	Chicago, Ill	Quarry and plant	Rankin.
Mississippi Valley Portland Cement Co.	Redwood, Miss.	do	Warren.
Clay:			
American Colloid Co	Skokie, Ill	Mine	Itawamba and Monroe.
Delta Macon Brick & Tile Co.	Macon, Miss	Mine and plant	Noxubee.
Dresser Minerals	Houston, Tex	do	Attala.
Filtrol Corp	Los Angeles, Calif.	do	Itawamba and Smith.
Holly Springs Brick & Tile	Holly Springs, Miss.	do	Marshall.
International Mineral & Chemical Corp.	Skokie, Ill	Mine	Monroe.
Jackson Ready-Mix Concrete.	Jackson, Miss	Mine and plant	Hinds.
Kentucky-Tennessee Clay Co.	Mayfield, Ky	Mine	Panola.
Oil Dri Production Co	Ripley, Miss	do	Tippah.
Tri-State Brick & Tile Co.	Jackson, Miss	Mine and plant	Hinds.
Wyandotte Chemicals Corp.	Wyandotte, Mich.	Mine	Tippah.
Lime: H. K. Porter Co., Inc.	Pascagoula, Miss.	Plant	Jackson.
Magnesium compounds: H. K. Porter Co., Inc., Refractories Division.	do	do	Do.
Sand and gravel:			
American Sand & Gravel Co.	Hattiesburg, Miss.	Stationary	Forrest.
Weymouth Construction Co.	Pleasant Hill, Miss.	do	De Soto.
Girod Motor Co., Inc	Vicksburg, Miss.	do	Warren.
Green Bros. Gravel Co	Crystal Springs, Miss.	do	Copiah.
Greenville Gravel Co	Greenville, Miss.	Dredge	Washington.
Memphis Stone & Gravel Co.	Memphis, Tenn.	Stationary	De Soto.
Hammett Gravel Co	Lexington, Miss.	do	Holmes.
St. Catherine Gravel Co.	Natchez, Miss	do	Adams.
Traxler Gravel Co., Inc.	Jackson, Miss	Stationary and dredge	Copiah.
West Point Gravel Co	West Point, Miss.	Dredge	Clay.
Riverside Gravel Co	McComb, Miss.	Stationary	Pike.
Oil and gas:			
Chevron Oil Company	Houston, Tex	Brookhaven Field	Lincoln.
		South Center Ridge Field	Smith.
		Cranfield Field	Adams and Franklin.
		Hub Field	Marion.
		Hub East Field	Do.
		Knoxo Field	Walthall.
		East Mallalieu Field	Lincoln.
		West Mallalieu Field	Do.
		Mize Field	Smith.
		Pisgah Field	Rankin.
		Puckett Field	Rankin and Smith.

See footnote at end of table.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Oil and Gas—Continued			
Chevron Oil Company—Continued			
		Raleigh Field	Simpson.
		Reedy Creek Field	Jones.
		Shongelo Creek Field	Smith.
Gulf Oil Corp	do	Baxterville Field	Lamar and Marion.
		Bolton Field	Hinds.
		Gwinville Field	Jefferson Davis.
		Heidelberg Field	Jasper.
		East Heidelberg Field	Do.
		West Heidelberg Field	Do.
		West Mallalieu Field	Lincoln.
		Pistol Ridge Field	Forrest and Pearl River.
		Soso Field	Jasper, Jones, and Smith.
		East Yellow Creek Field	Wayne.
Humble Oil & Refining Co.	do	Alloway Field	Adams.
		Baxterville Field	Marion and Lamar.
		Beaver Branch Field	Adams.
		Bentonia Field	Yazoo.
		Bryan Field	Jones and Jasper.
		Chaparral Field	Wayne.
		Cowpen Field	Adams.
		East Eucutta Field	Wayne.
		West Eucutta Field	Do.
		East Fairview Field	Adams.
		Fayette Field	Jefferson.
		Gilliard Lake Field	Adams.
		Gillsburg Field	Amite.
		Gwinville Field	Jefferson Davis.
		Hub Field	Marion.
		Hub East Field	Do.
		Junction City Field	Clarke.
		Kelly Hill Field	Wilkinson.
		Knoxo Field	Walthall.
		Lagrange Field	Adams.
		North Lake Lucille Field	Do.
		Loring Field	Madison.
		West Mallalieu Field	Lincoln.
		Mantua Field	Adams.
		Maxie Field	Forrest.
		Otter Lake Field	Adams.
		Pickens Field	Madison and Yazoo.
		Pistol Ridge Field	Pearl River.
		Sandy Hook Field	Marion.
		Shieldsboro Field	Adams.
		Sibley Field	Do.
		Waveland Field	Hancock.
		East Yellow Creek Field	Wayne.
		North Yellow Creek Field	Do.
		West Yellow Creek Field	Do.
Meason Operating Co	Natchez, Miss	Bourbon Field	Adams.
		North Carthage Point Field	Do.
		Clear Springs Field	Franklin.
		Courtland Field	Adams.
		Dexter Field	Walthall.
		Ellis Cliffs Field	Adams.
		Southeast Fairview Field	Adams.
		Fayette Field	Jefferson.
		North Fayette Field	Do.
		Flat Rock Field	Franklin.
		North Flat Rock Field	Do.
		North Fort Adams Field	Wilkinson.
		North Freewoods Field	Franklin.
		Gilliard Lake Field	Adams.
		Glasscock Field	Do.
		South Glenn Aubin Field	Do.
		Knoxo Field	Walthall.
		Knoxville Field	Franklin.
		Lagrange Field	Adams.
		Lazy Creek Field	Pike.
		Leesdale Tower Field	Franklin.
		West Locust Hill Field	Adams.
		Magnolia Field	Do.

See footnote at end of table.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Oil and Gas—Continued			
Meason Operating Co—Continued			
		Mantua Field	Adams.
		North Natchez Field	Do.
		Pine Mount Field	Do.
		Poplar Grove Field	Do.
		Richardson Creek Field	Franklin.
		Rose Hill Field	Wilkinson.
		Roxie Field	Franklin.
		Shieldsboro Field	Adams.
		Sibley Field	Do.
		Southwood Field	Do.
		Sunnyside Field	Jefferson.
		West Tar Creek Field	Wilkinson.
		Zeigler Creek Field	Franklin.
Pan American Petroleum Corp.	Tulsa, Okla	Barber Creek Field	Scott.
		Bay Springs Field	Jasper.
		Belmont Lake Field	Wilkinson.
		Blackburn Field	Jones.
		West Clara Field	Wayne.
		Clear Springs Field	Franklin.
		Collins Field	Covington.
		Diamond Field	Wayne.
		Dry Bayou Field	Franklin.
		East Fork Field	Amite.
		North East Fork Field	Do.
		North Freewoods Field	Franklin.
		Grange Field	Jefferson Davis.
		Hilo Field	Adams.
		South Ireland Field	Wilkinson.
		Kelly Hill Field	Do.
		Knoxville Field	Franklin.
		North Knoxville Field	Do.
		Lake Mary Field	Wilkinson.
		Lazy Creek Field	Pike.
		Levees Creek Field	Adams.
		Little Creek Field	Pike.
		Locust Hill Field	Adams.
		Lorene Field	Smith.
		Morgan Town Field	Adams.
		Pelahatchie Field	Rankin.
		Pine Mount Field	Adams.
		West Pine Ridge Field	Do.
		Quitman Bayou Field	Do.
		Siloam Field	Clay.
		Stringer Field	Jasper.
		Sylvarena Field	Smith.
		Tallahala Creek Field	Do.
		Thorn Field	Chickasaw.
		Wells Creek Field	Franklin.
		Zeigler Creek Field	Do.
Sun Oil Co	Philadelphia, Pa.	Baxterville Field	Lamar.
		Bolton Field	Hinds.
		Diamond Field	Wayne.
		West Eucutta Field	Do.
		East Franklin Field	Franklin.
		East Heidelberg Field	Jasper.
		Knoxo Field	Walthall.
		Kokomo Field	Do.
		Mantua Field	Adams.
		McComb Field	Pike.
		Mercer Field	Adams.
		Pistol Ridge Field	Forrest and Pearl River.
		Sandy Hook Field	Marion.
		Smithdale Field	Amite.
		East Summit Field	Pike.
		Tom Branch Field	Franklin.
		West Yellow Creek Field	Wayne.

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[1] Also limestone and marl.

The Mineral Industry of Missouri

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Missouri Geological Survey and Water Resources for collecting information on all minerals except fuels.

By Joseph C. Arundale [1] and James A. Martin [2]

Missouri's mineral output soared to a record high in 1968. Total value of the State's mineral production increased 16 percent over that of the previous year to an estimated $276 million.

New discoveries and plant construction have resulted in a broadly based expansion of Missouri's mineral industry—nearly doubling the total mineral output in the last decade.

Cement, lead, stone, iron ore, lime, and sand and gravel production accounted for over 88 percent of total mineral value. Increases in cement and lead production were the principal factors carrying the State's mineral output to the alltime high in value. The distribution of production value by mineral groups was nonmetals 63 percent, metals 32 percent, and mineral fuels 5 percent.

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Table 1.—Mineral production in Missouri [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite ______ short tons	331,780	$4,444	284,319	$4,102
Cement:				
Portland ______ thousand 376-pound barrels	15,044	52,119	20,081	71,206
Masonry ______ thousand 280-pound barrels	372	1,172	405	1,312
Clays ______ thousand short tons	2,305	6,220	2,433	6,158
Coal (bituminous) ______ do	3,696	15,573	3,205	13,460
Copper (recoverable content of ores, etc.) ______ short tons	3,215	2,458	5,494	4,598
Iron ore (usable) ______ thousand long tons, gross weight	1,871	26,673	1,648	23,585
Lead (recoverable content of ores, etc.) ______ short tons	152,649	42,742	212,611	56,180
Natural gas ______ million cubic feet	121	30	14	4
Sand and gravel ______ thousand short tons	9,716	12,556	10,649	14,204
Silver (recoverable content of ore, etc.) thousand troy ounces	226	351	341	731
Stone ______ thousand short tons	36,585	53,953	38,763	58,522
Zinc (recoverable content of ores, etc.) ______ short tons	7,430	2,057	12,301	3,321
Value of items that cannot be disclosed: Other nonmetals and fuels	XX	r 16,662	XX	18,572
Total	XX	r 237,010	XX	275,955
Total 1957–59 constant dollars	XX	217,659	XX	p 246,696

p Preliminary. r Revised.
XX Not applicable
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

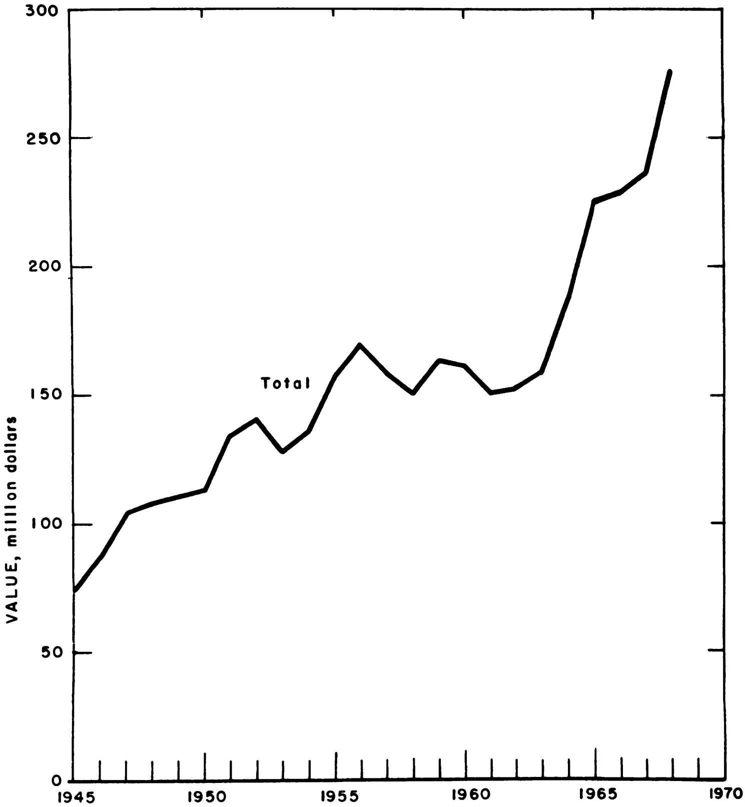

Figure 1.—Total value of mineral production in Missouri.

Table 2.—Value of mineral production in Missouri, by counties[1]

(Thousands)

County	1967 r	1968	Minerals produced in 1968 in order of value
Adair	W	W	Stone.
Andrew	W	---------	
Atchison	$10	$3	Petroleum.
Audrain	1,100	1,041	Clays.
Barry	98	W	Stone.
Barton	W	W	Stone, asphalt.
Bates	W	W	Stone, sand and gravel.
Benton	---------	6	Barite.
Boone	5,119	4,082	Coal, stone, sand and gravel, clays.
Buchanan	W	W	Stone, sand and gravel.
Butler	W	W	Sand and gravel, clays.
Caldwell	251	286	Stone, natural gas.
Callaway	1,690	1,666	Clays, stone, coal, sand and gravel.
Cape Girardeau	10,963	11,616	Cement, stone, clays, sand and gravel.
Carter	W	---------	
Cass	252	203	Stone, petroleum, clays.
Cedar	92	1	Sand and gravel.
Christian	W	747	Stone.
Clark	W	W	Do.
Clay	1,055	939	Do.
Clinton	210	260	Stone, natural gas.
Cole	415	407	Sand and gravel, stone.
Cooper	W	W	Stone, sand and gravel.
Crawford	4,037	4,904	Lead, copper, zinc, clays, silver.

See footnotes at end of table.

Table 2.—Value of mineral production in Missouri, by counties[1]—Continued

(Thousands)

County	1967 [r]	1968	Minerals produced in 1968 in order of value
Dade	$182	W	Stone, coal.
Dallas	W	$40	Stone.
Daviess	W	W	Stone, sand and gravel.
DeKalb	280	236	Stone.
Douglas	W	180	Sand and gravel.
Dunklin	W	90	Do.
Franklin	422	587	Stone, sand and gravel, clays.
Gasconade	1,826	1,603	Clays.
Gentry	W	W	Stone, sand and gravel.
Greene	3,719	3,762	Lime, stone, sand and gravel.
Grundy	W	280	Stone.
Harrison	360	W	Do.
Henry	7,642	W	Coal, stone.
Hickory	W	42	Stone.
Holt	W	W	Do.
Howard	W	W	Stone, sand and gravel.
Howell	261	308	Do.
Iron	8,159	14,357	Lead, iron ore, copper, stone, zinc, silver.
Jackson	11,969	13,409	Cement, stone, sand and gravel, clays, petroleum.
Jasper	3,627	4,272	Stone, sand and gravel, zinc, lead.
Jefferson	16,391	16,838	Cement, stone, sand and gravel, clays.
Johnson	W	W	Stone.
Knox	W	W	Do.
Laclede	W	W	Do.
Lafayette	232	115	Sand and gravel, stone.
Lawrence	W	W	Stone.
Lewis	W	W	Sand and gravel, stone.
Lincoln	366	401	Stone, sand and gravel, clays.
Linn	W	W	Stone.
Livingston	925	1,176	Stone, clays, sand and gravel.
Macon	W	W	Coal.
Madison	50	W	Stone.
Maries	W	---------	
Marion	W	W	Lime, stone.
Mercer	W	466	Stone.
Miller	58	258	Stone, sand and gravel.
Moniteau	64	54	Stone.
Monroe	442	418	Clays, stone, sand and gravel.
Montgomery	601	715	Stone, clays, sand and gravel.
Newton	213	139	Stone.
Nodaway	448	530	Stone, sand and gravel.
Oregon	---------	W	Stone.
Osage	W	W	Clays.
Ozark	W	W	Stone.
Pemiscot	W	W	Sand and gravel.
Perry	430	W	Stone.
Pettis	W	W	Do.
Phelps	150	285	Stone, clays, sand and gravel.
Pike	4,393	W	Cement, stone, clays.
Platte	221	269	Stone, clays.
Pulaski	W	W	Sand and gravel, stone.
Putnam	403	276	Coal, stone.
Ralls	8,351	11,078	Cement, stone, clays, sand and gravel.
Randolph	439	635	Stone.
Ray	568	651	Do.
Reynolds	10,780	23,508	Lead, zinc, copper, silver.
St. Charles	1,764	1,747	Stone, sand and gravel, clays.
St. Clair	W	W	Stone.
St. Francois	17,656	15,806	Lead, lime, stone, copper, iron ore, silver.
Ste. Genevieve	22,099	24,703	Lime, stone, sand and gravel.
St. Louis	27,355	30,516	Cement, stone, sand and gravel, clays, petroleum.
Saline	417	573	Stone.
Scotland	W	W	Do.
Scott	W	W	Do.
Shannon	W	W	Do.
Shelby	3	210	Do.
Stoddard	W	W	Sand and gravel.
Taney	W	---------	
Texas	W	---------	
Vernon	437	285	Coal, stone, petroleum.
Warren	390	344	Stone, clays, sand and gravel.
Washington	41,418	36,962	Iron ore, lead, barite, copper, zinc, sand and gravel, silver.
Wayne	346	250	Stone.
Worth	W	---------	
Wright	W	W	Stone.
Undistributed	15,916	41,420	
Total	237,010	275,955	

[r] Revised.

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties were not listed because no production was reported in 1967 or 1968: Bollinger, Camden, Carroll, Chariton, Dent, McDonald, Mississippi, Morgan, New Madrid, Polk, Ripley, Schuyler, Stone, Sullivan, and Webster Counties.

Table 3.—Indicators of Missouri business activity

	1967	1968 p	Change (percent)
Employment and labor force, annual average: Total labor force thousands	1,627.5	1,650.0	+1.4
Unemployment do	26.3	24.2	−8.0
Employment do	1,601.2	1,625.8	+1.5
Construction do	73.1	70.3	−3.8
Mining do	8.3	8.2	−1.2
All manufacturing do	455.2	460.4	+1.1
Payrolls, factory do	$2,721.1	$2,927.5	+7.6
Personal income:			
Total millions	$13,775	$14,891	+8.1
Per capita	$3,003	$3,220	+7.2
Construction activity:			
Building permits, total private nonresidential millions	$215.0	$268.2	+24.7
Cement shipments to and within Missouri thousand 376-pound barrels	9,355	9,709	+3.8
Farm marketing receipts millions	$1,342.4	$1,373.5	+2.3
Mineral production do	$237.0	$276.0	+16.4

p Preliminary.

Sources: Survey of Current Business, Construction Review, The Farm Income Situation, Employment and Earnings and Monthly Report on the Labor Force, and Bureau of Mines.

All but one of the planned lead production facilities in the new "Viburnum Trend" of southeast Missouri were completed and production was started during 1968. Construction of the unfinished mine-mill facility was nearing completion after being delayed by technical difficulties. Another major mine-mill project was announced. When all these facilities are operating, the district will have an annual capacity of at least 400,000 tons of lead metal.

Missouri was again the Nation's leading barite producer and was also a prominent producer of refractory clays and refractory products. Capacity of the State's cement industry exceeded 29 million barrels annually.

An issue of "Missouri Business" (organ of the Missouri State Chamber of Commerce) was devoted entirely to mining in Missouri. Included in the publication were discussions of history and current status of mining in Missouri, role of the University of Missouri at Rolla, Natural Resources Council of the State Chamber of Commerce, mining industry problems, manufacturing potential in the State's mining industry, national and international significance of Missouri's mineral resources, and programs of the U.S. Department of the Interior relating to Missouri.[3]

Trends and Developments.—The number of new manufacturing industries planned was greater than in any year since 1952. Additional new manufacturing plants were announced in the fabricated metal products industry and the chemical and allied products industry. The mining industry in the State accounted for $87.3 million, or 29 percent of all new and expanding industry investment, and over 41 percent of new industry investment.

The mining industry's trend and its contribution to Missouri's economic growth were discussed in an article.[4] The author contends that large investments in the State's mining industry, especially in the southeast, will create an estimated annual payroll of $30 million. The resulting taxes paid, impetus to the economy of small communities, and demand for State and private services will influence broadly the State's social and economic future.

A report outlining the market advantages of the St. Louis area for manufacturers of mining and construction equipment was prepared by the St. Louis Regional Industrial Development Corp.

Labor and Employment.—According to the Division of Employment Security, Missouri Department of Labor and Industrial Relations, the mineral industry employed 8,448 workers in 1968, continuing the increase in employment in that industry over the past several years. Employment in the metal mining segment showed a substantial increase to 3,486 employees, compared with 3,206 (revised figure) in 1967. Employment in coal mining decreased slightly to 668, from 676 in 1967. Employment in nonmetal mining decreased to 4,294 from 4,414 (revised figure) in 1967.

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[3] Missouri Business. Mining in Missouri. July–August 1968, 50 pp.

[4] Krueger, Harold. Mining—A Growth Factor. Missouri Business, January 1968, pp. 17–18.

Frequent labor-management disputes and strikes interrupted output of minerals particularly in the lead and iron industries.

Three-year labor contracts were signed between the United Steelworkers Union and all the major mining companies in the Viburnum Trend except American Smelting and Refining Co. (ASARCO), and negotiations were still in progress with ASARCO at yearend.

A 4-day labor strike of the Missouri Pacific Railroad starting February 6 had immediate adverse effect on the iron, lead, and cement industries of eastern Missouri.

Table 4.—Exploratory drilling in Missouri

(Linear feet)

Year	Churn	Rotary	Diamond
1964	148,098	34,136	289,225
1965	111,786	5,324	188,071
1966	133,879	4,036	292,699
1967	94,908	37,978	237,031
1968	45,272	43,011	211,493

Environment.—The minerals processors and consumers made several moves to control pollution. The Century Foundry in St. Louis installed new equipment to catch dust and other pollutants. P.P.G. Industries at Crystal City began studies to find a way to eliminate turbidity in Plattin Creek caused by discharge of fine sand and clay waste. Union Electric Co. was building 700-foot-high smokestacks for the coal-fired generating units at its new power-generating plant. Union Electric Co. also installed a full-scale system for the removal of sulfur dioxide from stack gases of a coal-fired steam generator at Meramec.

Progress reports on 13 research projects were presented at an annual meeting of the University of Missouri Water Resources Research Center, May 16, 1968. Projects included studies on availability of water resources, stream pollution, biology, and economic and legal aspects.

A new publication, "Missouri Monthly Water Summary," that carries information about surface water and groundwater conditions in Missouri was issued by the Water Resources Division of the U.S. Geological Survey and the Missouri Geological Survey.

A conference on water use law was held at the University of Missouri on May 3, 1968, at Columbia, sponsored by the School of Law of the University of Missouri and the Missouri Water Resources Research Center. Discussions included water law issues of the mineral industry.

Dundee Cement Co. installed a new water clarification system at its cement-producing facilities on the Mississippi River south of Clarksville. The Clarksville plant uses about 4 million gallons of water daily in the manufacture of slurry and as a coolant. Alum and sodium aluminate are added to the raw water in a clarifying basin, and coagulated silt and other impurities are segregated into a settling pond. The clarified water is then pumped to a temporary storage tank. Incoming river water measures about 1,000 parts per million (ppm) turbidity; after clarification and use, about 3 million gallons are returned to the river each day, measuring only about 2 ppm turbidity.

Missouri's adopted Water Quality Control Standards to protect the public health and welfare were found to be consistent with the Federal Water Pollution Control Act.

The Environmental Research Center of the University of Missouri at Rolla was engaged in a study of the progressive effects of industrialization on heretofore geochemically and ecologically unaltered streams in Missouri's new lead belt in the southeast part of the State. Other projects investigated different facets of water contamination by toxic metals such as those in mining and industrial waste water. The Center is supported by U.S. Public Health Service, Federal Water Pollution Control Administration, Office of Water Resources Research of the Department of the Interior (through the University of Missouri Water Resources Research Center), and industry and State funds. The Center conducted the "First Annual Environmental Engineering Conference" at Rolla, April 19–20.

The First Annual Air Pollution Conference,[5] sponsored by the University of Missouri and the Missouri Air Conservation Commission, was held November 19 at Columbia and was designed to review the technical "state-of-the-art" relating to processes that appeared to offer feasible systems for control of sulfur oxides. Federal, State, and municipal policies and regulations for control of air quality were also discussed.

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[5] College of Engineering, Extension Division of the University of Missouri-Columbia; and the Missouri Air Conservation Commission. Proceedings of the First Annual Air Pollution Conference; Nov. 19, 1968; Systems for the Control of Sulfur Oxides. Eng. Ext. Ser., No. 12, 60 pp.

A report[6] by the U.S. Department of Agriculture (USDA) indicated that Missouri had 59,100 acres of land disturbed by surface mining. Of that total, 15,400 acres had been reclaimed and 43,700 acres needed treatment. USDA was reported to have begun treatment of surface-mined lands in cooperation with soil and water conservation districts in Missouri.

Legislation and Government Programs.—The "Joint Interim Committee on Mining," created by the 74th General Assembly of the Missouri Legislature in 1967, continued studying the problem of mining in Missouri, applicability of mine safety legislation, and need for regulation and reclamation of open-pit and other methods of surface mining in the State. At yearend the Committee was preparing its report and recommendations for submission to the 75th General Assembly to be convened on January 8, 1969.

A symposium on mining taxation[7] was conducted by the University of Missouri at Rolla, October 17. Papers and discussions included a summary of recent mineral developments in Missouri, review of State mine taxation, tax history, and experiences of metals and nonmetals producers, tax climate needed to encourage new mineral industry investment, and State and local tax requirements.

A 5-year right-of-way and construction program of the Missouri State Highway Commission began July 1, 1968. Cost of the program, according to the Chief Engineer, is almost $1 billion. Construction, extending to all parts of the State, will require large quantities of mineral materials from local sources. The interstate, primary, and supplementary systems account for approximately $838 million of the total. The urban program amounts to about $158 million.

Exploration, Geologic Studies, and Maps.—Aeromagnetic surveys have covered over 15,000 square miles in Missouri. These surveys continued to be carried on cooperatively by the U.S. Geological Survey, Missouri Geological Survey, and several mining companies. The resultant maps are used in mineral exploration. In 1968 The

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[6] U.S. Department of Agriculture. Restoring Surface-Mined Land. Misc. Pub. 1082, April 1968, pp. 18.

[7] Scott, James J., and Carl R. Christiansen (eds.). Proceedings, Missouri Mining Industry Taxation Symposium, University of Missouri-Rolla, Oct. 17, 1968. Extension Division and Department of Mining & Petroleum Engineering, University of Missouri-Rolla, 1968, 88 pp.

Table 5.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	365	302	110	834	-------	15	17.99	405
Metal	2,292	271	622	4,974	2	188	38.20	3,823
Nonmetal and native asphalt	983	230	226	1,822	-------	56	30.73	2,370
Sand and gravel	556	241	134	1,139	-------	16	14.05	1,104
Stone	4,217	262	1,106	9,254	3	176	19.34	2,734
Total	8,413	261	2,197	18,023	5	451	25.30	2,649
1968:[p]								
Coal	420	296	124	941	-------	18	19.12	440
Metal	2,690	262	732	5,858	4	242	41.99	5,257
Nonmetal and native asphalt	915	236	217	1,756	-------	57	32.46	770
Sand and gravel	565	240	135	1,140	-------	20	17.55	774
Stone	4,140	270	1,116	9,261	3	191	20.95	2,464
Total	8,730	263	2,325	18,957	7	528	28.22	2,968

[p] Preliminary.

Hanna Mining Co. made available for publication five new aeromagnetic maps. The maps cover the following 15-minute quadrangles: Gerald, Ellington, Piedmont, Greenville, and Zalma. An index map of published aeromagnetic maps of Missouri is available from the Missouri Geological Survey.

During 1968 the Missouri Geological Survey contracted with Scintrex Airborne Geophysics, Inc., of Tulsa, Okla., to prepare aeromagnetic maps of the Bolivar, Buffalo, Morrisville, Strafford, Joplin East (E 1/2), Sarcoxie, Seneca (E 1/2), Neosho, and Ritchey 15-minute quadrangles in southwestern Missouri.

Drilling was reported on anomalies at Boss, Orla, and Peace Valley, but results have not been made public. Exploration at similar anomalies resulted in mine developments at Pea Ridge and Pilot Knob.

The Missouri Geological Survey undertook "Operation Basement" to learn more about Missouri's Precambrian rocks, which crop out in the St. Francois Mountains but are commonly encountered elsewhere only in the subsurface. Because the rocks are hosts for iron ore and have influenced the deposition of lead, zinc, and related ores in southeastern Missouri by their mutual relationships with Cambrian and younger strata, the project has three objectives that include:

1. Sampling and petrographic study.
2. Surface and subsurface investigations by conventional mapping, and geochemical and geophysical techniques.
3. Publication of results in reports and maps entitled "Contributions to the Precambrian Geology of Missouri." A study of platinum-group metals and sulfide minerals in the mafic rocks of the Shephard Mountain intrusive near Ironton was started by the U.S. Geological Survey (USGS). The study is part of the joint USGS-USBM Heavy Metals Program designed to stimulate domestic production of certain "heavy metals" in scarce supply.

In cooperation with the Bureau of Mines, the Missouri Division of Geological Survey and Water Resources sampled several old barite tailings ponds in east-central Missouri in order to estimate grade and tonnage of barite remaining in the tailings.

The "Bibliography of Missouri Geology for 1967" was published by the Missouri Geological Survey as Information Circular 19.

The 11th Biennial Report of the Missouri Geological Survey and Water Resources was published. The report summarizes research activities, information on cooperative programs, publications, and expenditures during the years 1966–68.

REVIEW BY MINERAL COMMODITIES

NONMETALS

The increased production of sand, gravel, crushed stone, and cement in 1968 appeared primarily to be the result of the largest highway construction program in Missouri history—1968 budget was $170 million, up $13 million from the 1967 record figure; and a significant increase in other types of construction.

Barite.—Since the inception of barite mining in Washington County in the mid-1800's more than 16 million tons have been produced in Missouri. In 1968, as in the past several years, Missouri led all States in barite production, and supplied almost one-third of the total U.S. output.

Table 6.—Barite sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	267	$3,451
1965	329	4,219
1966	337	4,280
1967	332	4,444
1968	284	4,102

Cement.—Substantially increased cement output in Missouri reflected production from the new Universal Atlas and Dundee cement plants, which went on-stream late in 1966 and in mid-1967, respectively. Missouri now ranks as the leading cement-producing State in the Mississippi Valley, with market areas as far away as Houston and Cincinnati.

River Cement Co. began an expansion program at its Selma plant, Jefferson County, designed to increase annual plant capacity by 2 million barrels. New installations included a second 560-foot-long kiln, raw and finished mills, cement cooler, storage silos, and dust collector. Work was scheduled for completion by early 1969. The company's barge fleet was being enlarged to handle increased shipments to distribution centers in Natchez, St. Louis, Kansas City, Cincinnati, and Memphis.

Cement prices in the St. Louis area increased to $4 per barrel early in the year. The 25-cent increase, the first since 1961, was attributed to higher labor and material costs.

Clays.—Clay output in Missouri in 1968 was the largest in several years.

A. P. Green Refractories Co., a subsidiary of United States Gypsum Co., announced that it would open a new clay mine and processing plant for bentonitic clay products near Oran, Scott County.

Carter-Waters Corp. invested more than $750,000 in installing a new 11- by 175-foot single rotary kiln at its New Market plant. The facility was designed to increase the output of expanded lightweight shale aggregate by 600 cubic yards per day.

Table 7.—Portland cement production and shipments

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1964	12,399	12,378	$42,618
1965	13,975	13,834	46,084
1966	13,956	13,848	46,228
1967	14,888	15,044	52,119
1968	19,806	20,081	71,206

A cooperative clay-testing program between the Bureau of Mines and the Missouri Division of Geological Survey and Water Resources was completed during the year. Clay samples from St. Charles, Lincoln, and Montgomery Counties were analysed and tested for extrusion, firing, and bloating qualities. Results of the testing program were being compiled.

Lime.—Missouri ranked fourth in the Nation in lime production. Lime was produced in Greene, Marion, and Ste. Genevieve Counties; dead-burned dolomite was produced in St. Francois County. Quicklime and hydrated lime were used chiefly for chemical purposes and as flux for manufacturing steel. Facilities were being expanded and modernized during the year.

Sand and Gravel.—The value of sand and gravel production attained a record high in 1968; production was about 1.4 million tons below the 1965 alltime high of 12 million tons. Sand and gravel was produced in 38 counties. Nearly 86 percent of total production was used in ready-mix concrete, concrete products, and paving. Industrial sand, produced in Jasper, Jefferson, St. Charles, and St. Louis Counties, comprised 9 percent of total tonnage and 27 percent of total value. Shipments of commercial production were 83 percent by truck, 9 percent by rail, and 8 percent by barge.

Table 8.—Clay sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Fire clay		Miscellaneous clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	1,002	$3,905	964	$969	1,966	$4,874
1965	1,128	4,313	1,098	1,126	2,226	5,439
1966	1,285	4,898	1,044	1,091	2,329	5,989
1967	1,131	4,747	1,174	1,473	2,305	6,220
1968	1,064	4,334	1,369	1,824	2,433	6,158

Table 9.—Lime sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	1,219	$14,328
1965	1,442	16,782
1966	1,494	17,910
1967–68	W	W

W Withheld to avoid disclosing individual company confidential data.

Stone.—Output of stone continued to increase with the general level of construction and economic activity. Limestone, granite, marble, sandstone, and traprock (chats) were produced. Limestone production from 77 counties supplied 98 percent of the total tonnage and 92 percent of the total value. Crushed and dimension granite were produced in Iron County. Dimension

Table 10.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	10,761	$12,762	722	$618	11,483	$13,380
1965	11,229	12,954	839	781	12,068	13,735
1966	10,454	13,283	248	257	10,702	13,540
1967	9,651	12,488	65	68	9,716	12,556
1968	10,597	14,153	52	51	10,649	14,204

Table 11.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,359	$3,139	3,949	$3,581
Paving	1,043	966	1,304	1,456
Fill	366	324	338	326
Other [1]	1,060	3,725	1,031	3,856
Total	5,828	8,154	6,622	9,219
Gravel:				
Building	1,808	2,269	2,127	2,730
Paving	1,737	1,883	1,716	2,070
Fill	116	67	33	19
Other [2]	162	115	99	115
Total	3,823	4,334	3,975	4,934
Total sand and gravel	9,651	12,488	10,597	14,153
Government-and-contractor operations:				
Sand: Paving	1	2	--------	--------
Gravel: Paving	64	66	52	51
Total sand and gravel	65	68	52	51
Grand total	9,716	12,556	10,649	14,204

[1] Includes railroad ballast, other construction sand, and industrial sand (unground and ground).

[2] Includes miscellaneous gravel, and other construction gravel.

marble was produced in Greene, Jasper, and Ste. Genevieve Counties; crushed marble was produced in Jasper, Jefferson, and Madison Counties. Dimension sandstone was quarried in Shannon County; crushed sandstone was produced in Jefferson County.

Asphaltic sandstone for road surfacing was produced in Barton County by Bar-Co-Roc Asphalt Co.

Sulfur.—American Metal Climax, Inc. (AMAX)-Homestake Lead Tollers completed a sulfur recovery plant at its Bixby lead smelter. About 50,000 tons of sulfuric acid per year will be recovered from the roasting of lead concentrates. Arrangements were made for sale of byproduct sulfuric acid to fertilizer manufacturers.

Construction commenced in July 1968 at the Herculaneum smelter of St. Joseph Lead Co. on a new sulfur-recovery and sulfuric acid plant which is scheduled to begin operating in mid-1969. Capacity of the plant was expected to be about 75,000 tons of acid per year.

The acid plant, being erected by Chemical Construction Corp. at an anticipated cost of $3.6 million, will utilize waste gas from updraft sintering of lead ore. Barge loading facilities on the Mississippi River will be constructed adjacent to the plant to permit barge transport of the acid as well as rail and truck shipment.

Table 12.—Stone sold or used by producers, by uses

Use	1967		1968	
	Quantity	Value	Quantity	Value
Dimension stone...approximate short tons..	19,660	$2,756,116	43,293	$2,623,449
Crushed and broken:				
Riprap....short tons..	2,455,989	1,825,351	3,208,038	2,909,703
Concrete aggregate, roadstone, etc..do....	20,572,740	26,475,675	21,334,807	28,787,728
Railroad ballast....do....	295,420	226,029	140,465	138,577
Agricultural....do....	3,827,108	6,480,075	4,361,115	7,076,589
Cement....do....	4,852,291	4,852,291	5,367,073	5,367,073
Other [1]....do....	4,561,604	11,337,219	4,308,057	11,618,881
Total crushed and broken....do....	36,565,152	51,196,640	38,719,555	55,898,551
Total stone....do....	36,584,812	53,952,756	38,762,848	58,522,000

[1] Includes stone for terrazzo, roofing granules, glass (1967), whiting, asphalt filler, other fillers, coal dust, filter stone, mineral foods, poultry grit, lime, refractory, flux, and miscellaneous uses.

Table 13.—Stone sold or used by producers, by kinds

Year	Granite (dimension)		Limestone		Sandstone (dimension)		Other stone [1]		Total stone	
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1964......	3,226	$292	30,567,256	$44,586	2,208	$29	914,026	$3,077	31,486,716	$47,984
1965......	3,124	234	34,952,692	49,770	2,258	52	1,289,359	3,518	36,247,433	53,574
1966......	2,471	253	33,698,016	48,468	1,500	36	1,537,760	4,636	35,239,747	53,393
1967......	2,047	246	35,496,586	49,133	1,500	36	1,084,679	4,538	36,584,812	53,953
1968......	W	W	37,898,613	54,099	W	W	864,235	4,423	38,762,848	58,522

W Withheld to avoid disclosing individual company confidential data; included in total.
[1] Includes granite, marble, miscellaneous stone, and sandstone.

METALS

Aluminum.—A design and construction contract for an aluminum reduction plant to be built by Noranda Manufacturing, Ltd., near New Madrid was awarded to Kaiser Engineers of Oakland, Calif. Ground was broken at midyear for the construction of a $6 million wire and rod mill of Noranda Aluminum Corporation of Toronto, Canada. Planned construction of a 500,000-kilowatt steam-electric generating plant to supply power for the aluminum plant will be supported by a $96.8 million bond issue approved by citizens of New Madrid and sold late in 1968. Another authorized bond issue of $85 million will finance construction of roads, sewers, water lines, docks, and the two plants. The wire and rod mill will employ about 100 persons. Late 1970 is the target date for completion of the reduction plant.

Copper.—Output of copper in Missouri increased significantly in 1968 as a result of operating copper circuits in the mills of the new lead belt.

Iron Ore and Steel.—Pilot Knob Pellet Co. began operating an iron ore mine, mill, and pellet plant in Iron County at midyear; first shipment of iron pellets was made on June 29 to the Granite City Steel Co. facilities at Granite City, Ill., near St. Louis. The pellets averaged about 64 percent iron. Near capacity output of pellets was soon attained, but strikes and technical problems at consuming plants necessitated a curtailment of shipments during the last half of the year.

The Pilot Knob orebody was developed by two circular shafts and prepared for contour mining of ore by a unique stoping system that is a combination of room-and-pillar and sublevel methods. The room-and-pillar headings (14 by 27 feet) are used to develop the sublevels and floors and pillars are broken to a slot at the end of the stope. The treatment plant has a rated capacity of 1 million tons per year and is equipped with a wet semiautogenous grinding system, a magnetic separation plant and a traveling-grate pelletizer. The Pilot Knob orebody, mining method, mill, and pelletizer were described in an article.[8]

Missouri's other major iron ore producer, Meramec Mining Co., Pea Ridge mine, Washington County, also restricted shipments of pellets, because of strikes at consuming plants, cutbacks in steel production, and a plant-wide work stoppage of 5½ weeks.

An underground primary ore-crushing system at the Pea Ridge mine was scheduled for completion in March 1969.

The Meramec Mining Co. also began producing high-quality iron oxide for use in the ceramic ferrite industry. The first shipment was made in March. Ceramic ferrite, produced from magnetic iron ore, is used mainly in electrical and electronic components.

Table 14.—Iron ore (usable)

(Thousand long tons and thousand dollars)

Year	Quantity	Value
1964	1,116	$14,907
1965	1,784	24,607
1966	1,887	26,450
1967	1,871	26,673
1968	1,648	23,585

Table 15.—Ferrous scrap and pig iron consumption

(Thousand short tons)

Year	Ferrous scrap	Pig iron	Total scrap and pig iron
1964	1,029	40	1,069
1965	1,096	42	1,138
1966	1,063	41	1,104
1967	1,051	31	1,082
1968	1,051	25	1,076

Lead.—St. Joseph Lead Co. (St. Joe) began producing lead ore from development headings at its new 1,180-foot Goose Creek shaft 1½ miles northeast of its Indian Creek mine and mill in Washington County. Ore reserves are expected to add 12 to 15 years to the production life of the Indian Creek property at present milling rates. A copper circuit was added to the Fletcher mill. This firm reported application of a modified "down-the-hole-drill" device, which drills and places casing in one operation. The mobile, large-capacity underground equipment, modified for use at the Fletcher mine, permitted production rates almost six times the maximum level attained with 1958's equipment and methods.

Late in the year, St. Joe announced preparations to sink a shaft on its Brushy Creek property in extreme north central Reynolds County in order to comply with Federal land regulations of Clark National Forest. St. Joe was operating from four production shafts in the Viburnum Trend, two in the Indian Creek district, and one in the old Lead Belt.

The Herculaneum smelter produced a record tonnage of refined lead and lead alloys in 1968. Modification and improvement of equipment and extensive personnel training was completed.

The Magmont mine of Cominco American, Inc., and Dresser Industries, Inc., Iron County, delivered its first lead concentrates to the Missouri Lead Operating Co. (MOLOC) smelter owned by AMAX-Homestake Lead Tollers on July 5. At yearend, production at the Magmont operations had nearly reached a rated annual capacity of 1 million tons of ore from which about 50,000 tons of lead metal will be recovered. Recovery of zinc concentrates began in the Magmont mill later in the year.

There was a change in the corporate structure of the new lead smelter near Bixby. The smelter is owned by the partnership AMAX-Homestake Lead Tollers. The lead mine and mill at Buick are owned jointly by AMAX Lead Company of Missouri and the Homestake Lead Company of Missouri. In turn, MOLOC has an agreement to operate the smelter for the AMAX-Homestake Lead Tollers and also an agreement to operate the Buick mine and mill for the two mining companies. The exploration and development project began as a joint venture of American Metal Climax, Inc., and the Homestake Mining Co.

The smelter at Bixby, which has a capacity of 100,000 tons of refined lead per year, became operational in July 1968 and commenced processing ore on a toll basis.

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[8] Engineering and Mining Journal. Hanna Mining—Profile of a Company on the Move. V. 169, No. 11, November 1968, pp. 75–107.

Table 16.—Tenor of lead and zinc ore milled and concentrates produced in Missouri[1]

		1967	1968
Concentrate production:			
Lead	short tons	220,096	297,053
Zinc	do	15,512	25,427
Concentrate obtained from:			
Lead	percent	3.96	4.67
Zinc	do	0.28	0.40
Metal content of ore:[2]			
Lead	do	2.74	3.34
Zinc	do	0.13	0.19
Average lead content of galena concentrate	do	70.77	73.03
Average zinc content of sphalerite concentrate	do	53.22	53.45
Average value per ton:			
Galena concentrate	do	$162.77	$184.47
Sphalerite concentrate	do	$91.00	$96.95
Total material milled	short tons	5,563,824	6,356,252

[1] Includes southwest Missouri.
[2] Figures represent metal content of crude ore only as recovered in the concentrate; data on tailing losses not available.

Table 17.—Mine production of silver, copper, lead, and zinc, in terms of concentrates and recoverable metals[1]

Year	Mines producing	Material sold or treated Crude ore (short tons)	Lead concentrates (Galena)		Zinc concentrates (Sphalerite)		Recoverable metal content[2]			
							Lead		Zinc	
			Short tons	Value[3] (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1964[4]	5	4,965,814	167,630	$28,125	3,115	$205	120,148	$31,479	1,501	$408
1965[4]	5	5,279,420	186,368	36,537	8,792	891	133,521	41,659	4,312	1,259
1966	7	5,387,330	185,410	33,816	8,525	795	132,255	39,981	3,968	1,151
1967	10	5,563,824	220,096	35,824	15,512	1,412	152,649	42,742	7,430	2,057
1968	9	6,356,252	297,053	54,797	25,427	2,465	212,611	56,180	12,301	3,321

Year	Silver		Copper		Total value (thousands)
	Troy ounces	Value (thousands)	Short tons	Value (thousands)	
1964[4]	-------	------	2,059	$1,343	$33,230
1965[4]	299,522	$387	2,331	1,650	44,955
1966	-------	------	3,913	2,831	43,963
1967	226,168	351	3,215	2,458	47,608
1968	340,856	731	5,494	4,598	64,830

[1] Based on Missouri ore "dirt" and old tailing treated at mills.
[2] In calculating metal content of ores from assays, allowance has been made for smelting losses. In comparing values of concentrate "ore" and metal, value for concentrate is that received by producer, whereas value of lead and zinc is calculated from average price for all grades.
[3] Values are arbitrary, because part of lead concentrate is smelted by producer.
[4] Excludes southwest Missouri.

The mine at Buick was nearing production stage at yearend. Lack of trained labor delayed the project and added to preproduction costs. The company reported that substantially more ore reserves were found during the construction period. Extensive air pollution control measures applied at the smelter to recover sulfur from exhaust gases included construction of a sulfuric acid plant.

Ozark Lead Co. completed construction work in May at its mine-mill complex and began checkout operations. The first lead concentrate was shipped to the American Smelting and Refining Co. (ASARCO) smelter at Glover, in early June and the first zinc concentrate was shipped early in July to American Zinc Co. at Monsanto, Ill. The mine-mill complex was designed for a 6,000-ton-per-day capacity which should yield 60,000 tons of lead metal and 8,000 tons of zinc metal annually.

The new 80,000-ton-per-year lead smelter and refinery of ASARCO at Glover was completed during 1968. Limited shipments of lead began in July. On September 10, a labor strike stopped operations and there was no production for the balance of the year. The Glover plant is expected to yield 5,500 tons of refined lead per month.

MINERAL FUELS

Small quantities of petroleum and natural gas were produced, but drilling and production were down from previous levels.

Bituminous coal output was down. New and expanded coal-fired steam powerplants may increase the demand for coal in the State, but the effects of restrictions on sulfur content of coal burned by utilities may hamper increased production.

Coal.—Kennecott Copper Corp. purchased Peabody Coal Co. of St. Louis on March 29, 1968, in a transaction estimated at $621.5 million. Peabody, operator of 40 coal mines in eight States, including Missouri, planned to continue under its prior name and management as a wholly owned Kennecott subsidiary. The merger was contested by the Federal Trade Commission (FTC) and the outcome was not resolved at yearend.

Peabody Coal Co. reported that it would increase coal production in 1969 at the Bee Veer mine in Macon County to supply fuel for the expanded electric generating facilities at Associated Electric Cooperative's Thomas Hill plant in Randolph County.

The Pittsburg & Midway Coal Mining Co. continued development of its Barton County coal mine to supply Empire District Electric Co.'s new steam-electric generating plant near Asbury, Jasper County. Shipments of coal were to begin in 1970.

Union Electric Co. began operating its second 525,000-kilowatt unit at Portage des Sioux in St. Charles County during the year. Construction continued throughout the year at the Company's 1.2 million kw plant near Godadie in Northeastern Franklin County; the first 600,000 kw unit was expected to be on stream by mid-1970.

Table 18.—Coal (bituminous) production

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	3,254	$13,285
1965	3,564	14,779
1966	3,582	14,834
1967	3,696	15,573
1968	3,205	13,460

Petroleum and Natural Gas.—Forty-seven holes were drilled for petroleum in the State during the year. A breakdown showed 25 producing wells, two dry holes, seven service or injection wells, and 13 structure and stratigraphic tests. The 25 oil wells were classed as development or extension wells and were drilled in west central Missouri. No new oilfields were discovered in 1968.

The Missouri Geological Survey assembled a card file with data on all of the 15,000 oil and gas wells drilled in the State. Accompanying the card file are maps which show the location of and information about wells by means of various symbols.

Two papers were presented by the staff of Missouri Geological Survey relating to petroleum.[9]

Mississippi River Transmission Corp. announced plans for a $25 million expansion of its natural gas pipeline system to increase supplies by nearly 15 percent to the St. Louis metropolitan area. The new facilities will enable the pipeline company to provide an additional 100 million cubic feet per day. The company's pipeline capacity was about 720 million cubic feet per day in 1968 as compared with 472 million in 1960. The company, a subsidiary of the Mississippi River Corporation, filed an application with the FPC for authorization to install about 195 miles of 26-inch diameter pipeline in its system from northern Louisiana and Arkansas. Peak day deliveries of 800 million cubic feet per day are expected in the near future.

First flow of natural gas began through a new 20-inch pipeline 135 miles long from gasfields in eastern Oklahoma and western Arkansas to southwest Missouri. The $11.7 million pipeline, a joint project of Cities Service Gas Company and Arkansas Louisiana Gas Co., will transport an average 100 million cubic feet of gas per day.

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[9] Wells, J. S., and K. H. Anderson. The Forest City Basin of Missouri, Kansas, Nebraska, and Iowa. AAPG Bull., v. 52, No. 2, February 1968, pp. 264–281.

———. Heavy Oil in Western Missouri. AAPG Bull., v. 52, No. 9, September 1968, pp. 1720–1731.

Table 19.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt-native: Bar-Co Roc Asphalt Co.	Iantha, Mo	Mine	Barton.
Barite:			
Dresser Minerals	Houston, Tex	do	Washington.
Milchem, Incorporated	do	Mine and mill	Do.
National Lead Co., Baroid Division.	do	do	Do.
National Lead Co., DeLore Division.	St. Louis, Mo	Mill	St. Louis.
Chas. Pfizer & Co., Inc	Mineral Point, Mo	Mine and mill	Washington.
Cement:			
Alpha Portland Cement Co	Easton, Pa	Quarry and plant	St. Louis.
Dundee Cement Co	Dundee, Mich	do	Pike.
Marquette Cement Mfg. Co	Chicago, Ill	do	Cape Girardeau.
Missouri Portland Cement Co.	St. Louis, Mo	do	Jackson, St. Louis.
River Cement Company	do	do	Jefferson.
Universal Atlas Cement Division, United States Steel Corp.	Pittsburgh, Pa	do	Ralls.
Clay and shale:			
Allied Chemical Corp	Morristown, N.J	Mine and plant	Gasconade.
Alton Brick Co	Maryland Heights, Mo	do	St. Louis.
Carter-Waters Corp	Kansas City, Mo	do	Platte.
Dundee Cement Co	Dundee, Mich	do	Pike.
A. P. Green Refractories Co	Mexico, Mo	do	Audrain, Gasconade, Osage.
Harbison-Walker Refractory Co.	Pittsburgh, Pa	do	Audrain, Callaway, Gasconade, Lincoln, Warren.
Kaiser Refractories	Mexico, Mo	do	Audrain, Callaway, Franklin, Gasconade, Montgomery, Osage, Warren.
Marquette Cement Mfg. Co	Chicago, Ill	do	Cape Girardeau.
Midland Brick & Tile Co	Chillicothe, Mo	do	Livingston.
Missouri Portland Cement Co	St. Louis, Mo	do	Jackson, St. Louis.
H. K. Porter Co., Inc	do	do	Callaway, Crawford, Franklin, Gasconade, Monroe, St. Louis.
Universal Atlas Cement Division, United States Steel Corp.	Pittsburgh, Pa	do	Ralls.
Walsh Refractories Corp	St. Louis, Mo	Mine and plant	Audrain, Callaway, Franklin, Gasconade, Monroe, Phelps.
Wellsville Fire Brick Co	Wellsville, Mo	do	Audrain, Montgomery.
Coal:			
Clayton-Hensley Coal Co	Fulton, Mo	Strip mine	Callaway.
Ellis Coal Company	Bronaugh, Mo	do	Vernon.
Kirkville Coal Co., Inc	Centerville, Iowa	do	Putnam.
Madole Bros. Coal Co	Windsor, Mo	do	Henry.
Nichols Coal Company	Rich Hill, Mo	do	Vernon.
Palmer Coal & Rock Co., Inc.	Fort Scott, Kansas	do	Do.
Peabody Coal Co	St. Louis, Mo	do	Boone, Henry, Macon.
Putnam County Stone Co	Unionville, Mo	do	Putnam.
Tyler Coal Co	Jerico Springs, Mo	do	Dade.
Iodine (consumption):			
Hoffman-Taff, Inc	Springfield, Mo	Plant	Greene.
Interstate Chemical Co., Inc	Kansas City, Mo	do	Jackson.
Mallinckrodt Chemical Works.	St. Louis, Mo	do	St. Louis.
Iron ore:			
Meramec Mining Co	Sullivan, Mo	Underground mine.	Washington.
Pilot Knob Pellet Co	do	do	Iron.
Lead and zinc:			
St. Joseph Lead Company	Bonne Terre, Mo	do	Crawford, Iron, St. Francois, Reynolds, Washington.
Cominco American, Inc	Salem, Mo	do	Iron.
Ozark Lead Co	Sweetwater, Mo	do	Reynolds.

Table 19.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Lime:			
Ash Grove Lime & Portland Cement Co.	Kansas City, Mo	Quarry and plant	Greene.
Marblehead Lime Co	Chicago, Ill	do	Marion.
Mississippi Lime Co	Alton, Ill	do	Ste. Genevieve.
Valley Dolomite Corp	St. Louis, Mo	do	St. Francois.
Roofing Granules: GAF Corp	Annapolis, Mo	do	Iron.
Sand and gravel:			
Eureka Sand & Gravel Co	Eureka, Mo	Stationary	St. Louis.
Holliday Sand & Gravel	Overland Park, Kans	Portable, dredge	Various.
Independent Gravel Co	Joplin, Mo	Stationary	Jasper.
Manley Sand Co., Division Martin Marietta Corp.	Rockton, Ill	do	Jefferson.
Mississippi River Sand & Materials Co.	St. Louis, Mo	Stationary and dredge.	Cooper, St. Louis.
Missouri Gravel Co	Moline, Ill	Dredge	Lewis.
Pennsylvania Glass Sand Corp.	Berkeley Springs, W. Va	Stationary	St. Charles, St. Louis.
PPG Industries, Inc	Pittsburgh, Pa	Stationary—underground.	Jefferson.
St. Charles Sand Co	Bridgeton, Mo	Stationary	St. Louis.
Simpson Sand & Gravel Co	Valley Park, Mo	Dredge	Do.
Simpson Material Co	do	do	Jefferson, St. Louis.
Snyder Quarries	Gallatin, Mo	Portable	Daviess.
Stewart Sand & Material Co	Kansas City, Mo	Stationary	Jackson.
Taylor Sand & Gravel Co	Caruthersville, Mo	Stationary, portable and dredge.	Pemiscott.
Winter Bros. Material Co	St. Louis, Mo	Stationary	St. Louis.
Stone:			
Beyer Crushed Rock Co	Kansas City, Mo	Quarry	Jackson.
Bussen Quarries, Inc	St. Louis, Mo	do	Jefferson, St. Louis.
Carthage Marble Corp	Carthage, Mo	do	Greene, Jasper.
Central Stone Company	Moline, Ill	do	Pike.
Dundee Cement Co	Dundee, Mich	do	Do.
Gordon Bros. Quarries, Inc	Forest City, Mo	do	Holt.
Green Quarries, Inc	Carrollton, Mo	do	Livingston, Randolph, Ray.
W. J. Menefee Constr. Co	Sedalia, Mo	do	Laclede, Phelps, Ozark, Pettis.
Mississippi Lime Co	Alton, Mo	do	Ste. Genevieve.
Missouri Portland Cement Co	St. Louis, Mo	do	Jackson, St. Louis.
River Cement Co	do	do	Jefferson.
Snyder Quarries, Inc	Gallatin, Mo	do	Daviess.
Union Quarries, Inc	Overland Park, Kans	do	Jackson.
Universal Atlas Cement Div., U.S. Steel Corp.	Pittsburgh, Pa	Quarry	Ralls.
Vigus Quarries, Inc	St. Louis, Mo	do	Jefferson.
West Lake Quarry & Material Co., Inc.	Bridgeton, Mo	do	St. Louis, Scott.
Tripoli: The Carborundum Co., American Tripoli Division.	Seneca, Mo	Mill	Newton.
Vermiculite: Zonolite Division, W. R. Grace & Co.	Cambridge, Mass	Exfoliating plant	St. Louis.

The Mineral Industry of Montana

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Montana Bureau of Mines and Geology for collecting information on all minerals except fuels.

By Fred V. Carrillo, [1] Mary Anne McComb, [2] and William N. Hale [1]

In 1968, Montana mineral production was valued at $228.1 million, an increase of 22.3 percent over the 1967 value, but still below the record high reached in 1966. Both 1967 and 1968 mineral production were adversely affected by a nationwide labor dispute which idled the copper industry. The increase in the value of mineral production was due mainly to the 42-percent increase in the value of petroleum production. Petroleum production value had reached record levels each year since 1964, and in 1968 accounted for 55 percent of the State's total value of mineral production. Except for some construction materials, all major minerals rose in value of production.

The Anaconda Company announced that

Table 1.—Mineral production in Montana [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] thousand short tons	46	$50	30	$34
Coal (bituminous and lignite) do	371	996	519	1,214
Copper (recoverable content of ores, etc.) short tons	65,483	50,063	69,480	58,151
Gem stones	NA	109	NA	109
Gold (recoverable content of ores, etc.) troy ounces	9,786	343	13,385	[3] 525
Iron ore (usable) thousand long tons, gross weight	10	81	12	W
Lead (recoverable content of ores, etc.) short tons	898	251	1,870	494
Lime thousand short tons	143	1,765	179	2,005
Manganese ore and concentrate (35 percent or more Mn) short tons, gross weight	W	W	4,649	213
Manganiferous ore and concentrate (5 to 35 percent Mn) short tons, gross weight	2,763	16	2,063	22
Natural gas million cubic feet	25,866	2,173	19,313	1,757
Petroleum (crude) thousand 42-gallon barrels	34,959	87,543	48,460	124,488
Pumice thousand short tons	---------	---------	93	327
Sand and gravel do	12,339	10,655	8,762	7,754
Silver (recoverable content of ores, etc.) thousand troy ounces	2,066	3,203	2,133	4,574
Stone thousand short tons	4,782	6,037	3,314	4,878
Zinc (recoverable content of ores, etc.) short tons	3,341	925	3,778	1,020
Value of items that cannot be disclosed: Antimony (1967), cement, clays (bentonite) fluorspar, gypsum, natural gas liquids, peat, phosphate rock, talc, tungsten, vermiculite and values indicated by symbol W	XX	22,314	XX	20,566
Total	XX	186,524	XX	228,131
Total 1957–59 constant dollars	XX	r 168,939	XX	p 202,676

p Preliminary. r Revised. NA Not available. XX Not applicable.

W Withheld to avoid disclosing individual company confidential data.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes bentonite; included with "Value of items that cannot be disclosed."

[3] Based on average U.S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968, and the New York selling price for the remainder of the year.

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[1] Geologist, Bureau of Mines, Albany. Oreg.

[2] Economist, Bureau of Mines, Albany, Oreg.

Table 2.—Value of mineral production in Montana, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968, in order of value
Beaverhead	W	$716	Sand and gravel, tungsten, stone, silver, lead, talc, zinc, gold, copper.
Big Horn	$773	820	Petroleum, stone, lime, sand and gravel, coal, natural gas.
Blaine	662	563	Petroleum, sand and gravel, natural gas, coal, stone.
Broadwater	270	270	Iron ore, lead, sand and gravel, silver, zinc, stone, gold, copper.
Carbon	7,950	7,459	Petroleum, sand and gravel, stone, natural gas.
Carter	W	85	Petroleum, clays, sand and gravel.
Cascade	904	265	Sand and gravel, silver, stone, zinc, clays, lead, copper.
Chouteau	(1)	173	Sand and gravel, stone.
Custer	92	W	Sand and gravel.
Daniels	339	166	Sand and gravel, petroleum.
Dawson	4,009	2,837	Petroleum, sand and gravel, stone.
Deer Lodge	2,045	1,895	Lime, stone, sand and gravel, silver, tungsten, copper, gold.
Fallon	20,632	19,662	Petroleum, natural gas.
Fergus	281	W	Gypsum, sand and gravel, stone, clays, silver, lead.
Flathead	653	857	Sand and gravel, silver, stone, lead, zinc, copper, gold.
Gallatin	4,020	W	Cement, stone, sand and gravel, clays, lead, zinc, silver.
Garfield	408	-------	
Glacier	2,159	1,891	Petroleum, sand and gravel,
Golden Valley	-------	31	Sand and gravel.
Granite	W	5,478	Phosphate rock, stone, silver, sand and gravel, zinc, manganese ore, lead, copper, manganiferous ore, gold.
Hill	144	125	Sand and gravel.
Jefferson	5,732	W	Cement, stone, silver, sand and gravel, gold, lead, zinc, copper, clays.
Judith Basin	-------	14	Lead, silver, zinc, copper, gold.
Lake	167	77	Sand and gravel, peat, stone.
Lewis and Clark	818	875	Zinc, lead, sand and gravel, silver, stone, gold, copper.
Liberty	1,683	1,713	Petroleum, natural gas.
Lincoln	5,545	5,325	Vermiculite, sand and gravel, stone, zinc, lead, silver.
McCone	4,155	2,488	Petroleum, sand and gravel, stone.
Madison	1,404	W	Talc, stone, silver, gold, sand and gravel, zinc, copper, lead.
Meagher	W	82	Sand and gravel, lead, silver, zinc, gold, copper, stone.
Mineral	77	200	Silver, copper, lead, sand and gravel, gold, zinc.
Missoula	640	W	Sand and gravel, stone, gold, silver, copper, zinc, lead.
Musselshell	3,345	3,684	Petroleum, coal, sand and gravel.
Park	298	177	Stone, sand and gravel, copper, gold, silver.
Petroleum	273	515	Petroleum, sand and gravel.
Phillips	13	25	Sand and gravel, stone.
Pondera	90	54	Petroleum.
Powder River	4,410	42,800	Petroleum, sand and gravel, pumice, natural gas, coal.
Powell	W	W	Phosphate rock, sand and gravel, copper, silver, gold, lead, zinc.
Prairie	W	49	Sand and gravel, stone.
Ravalli	W	W	Fluorspar, silver, lead, sand and gravel, zinc, copper, stone, gold.
Richland	1,977	4,561	Petroleum, coal, lime, sand and gravel, stone.
Roosevelt	5,902	5,482	Petroleum, sand and gravel.
Rosebud	1,970	2,843	Petroleum, clays, coal, pumice, stone, sand and gravel.
Sanders	22	116	Sand and gravel, lead, zinc, silver, copper, gold.
Sheridan	7,204	6,453	Petroleum.
Silver Bow	53,878	61,894	Copper, silver, gold, sand and gravel, manganese ore, stone.
Stillwater	89	152	Natural gas, sand and gravel, petroleum, stone.
Sweet Grass	14	57	Sand and gravel.
Teton	41	37	Sand and gravel, petroleum.
Toole	4,139	3,448	Petroleum, natural gas, sand and gravel.
Treasure	11	-------	
Valley	32	67	Sand and gravel.
Wheatland	-------	32	Sand and gravel, stone.
Wibaux	3	14	Sand and gravel.
Yellowstone	3,385	2,348	Sand and gravel, petroleum, lime, clays, stone.
Combined counties [2]	21,590	21,978	
Undistributed [3]	12,276	17,278	
Total	186,524	228,131	

[1] Less than ½ unit.

[2] Petroleum and natural gas production from fields underlying two or more counties.

[3] Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

as of January 1, 1968, total loss due to the copper strike was just under $60 million, based on wages, services, freight, supplies, and taxes. The average wage loss to the striker by January 1 was $3,300. This strike proved to be Montana's longest, lasting 8 months.

A report which discussed markets for industrial minerals and rocks found in Montana was published.[3]

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[3] Chelini, J. M. Market Study and Compendium of Data on Industrial Minerals and Rocks of Montana. Montana Bur. Mines and Geol., Bull. 62, October 1967, 90 pp.

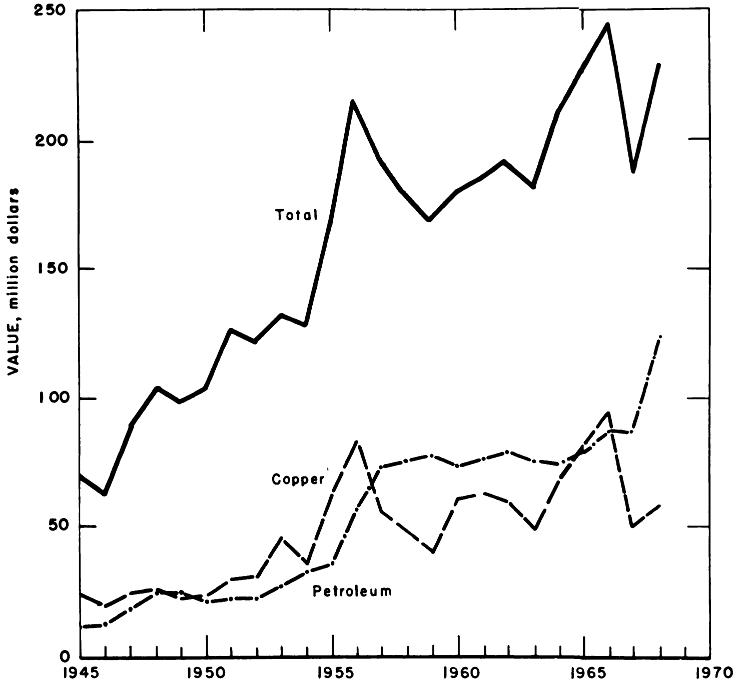

Figure 1.—Value of copper, petroleum, and total value of mineral production in Montana.

The Montana Bureau of Mines and Geology described geochemical investigations in Lincoln and Flathead Counties in a new publication.[4]

Uuno M. Sahinen, Director of the Montana Bureau of Mines and Geology, reported at the December meeting of the Northwest Mining Association that 251 mining operations were active in the State. Of these operations, 143 reported some production during the year. Several major exploration companies were active in the State, and 23 new mining companies were incorporated during the year.

Economic Activity and Employment.—Until the copper strike cut heavily into the Montana economy, the State had experienced 7 years of consecutive growth. In spite of this strike, 1967 set a new employment record, and each month in 1968 experienced record high employment. The average for the year was 195,400, the highest yearly average of nonfarm employment ever achieved in the State. Montana's economic base in 1968 and previous years emphasized the service industries. On a national average, 55 percent of the U.S. work force was employed in dispensing services rather than goods. In Montana, a full 79 percent was employed in service industries. This was probably the major reason why the overall employment picture was good, as mining employment had not returned to 1966 levels.

The construction industry saw an increase in activity, but not sufficient enough to change employment in this sector.

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[4] Sahinen, U. M., W. M. Johns, and D. C. Lawson. Geochemical Investigations in Lincoln and Flathead Counties, Montana. Montana Bur. Mines and Geol., Bull. 61, 1967, 18 pp.

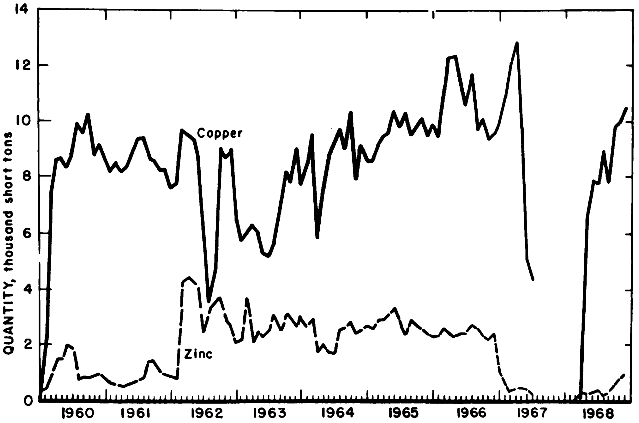

Figure 2.—Mine production of copper and zinc in Montana, by months, in terms of recoverable metals.

Table 3.—Indicators of Montana business activity

	1967	1968 p	Change (percent)
Employment, annual average:			
Total nonagricultural industries...thousands	190.2	195.3	+2.7
Total manufacturing...do	22.4	23.3	+4.0
Lumber and timber industries...do	8.7	9.0	+3.4
Metal-mining and primary-metal industries...do	6.4	6.0	−6.2
Contract construction...do	11.7	11.7	--------
Transportation and utilities...do	17.8	17.7	−.6
Personal income:			
Total...millions	$1,939.0	$2,022.0	+4.3
Per capita	$2,773.0	$2,917.0	+5.2
Construction activity:			
Building permits...millions	$25.0	(1)	--------
Heavy engineering awards...do	$170.6	$66.6	−61.0
Highway construction contracts awarded...do	$46.9	$39.1	−16.6
Cement shipments to and within Montana thousand 376-pound barrels	$1,091.6	$1,483.3	+35.9
Farm marketing, cash receipts...millions	$488.0	$476.9	−2.3
Mineral production...do	$186.5	$228.1	+22.3

p Preliminary.
[1] Data no longer available, see text.

Sources: Survey of Current Business, Construction Review, Pacific Builder & Engineer, Montana Highway Commission, The Farm Income Situation, Montana Labor Market, and Bureau of Mines.

Table 4.—Employment for selected mineral industries

Year	Total mining	Metal mining	Nonmetals, including coal	Petroleum and natural gas	Processing	
					Primary metals	Petroleum refining
1964	7,600	4,800	900	1,900	3,300	1,200
1965	7,500	4,600	1,100	1,800	3,600	1,100
1966	7,400	4,800	1,000	1,600	3,900	1,100
1967	5,900	3,200	1,000	1,700	3,200	1,000
1968 p	5,300	2,300	1,000	2,000	3,700	1,100

p Preliminary.

Source: Montana State Employment Service, Montana Labor Market. Excludes proprietors and self-employed. Industry groups may vary from those in the Bureau of Mines canvass.

Table 5.—Hours and earnings data in mining and related industries

Industry	1964	1965	1966	1967 [1]	1968 [2]
Mining:					
Average weekly earnings	$114.76	$119.12	$125.51	$131.86	$136.00
Average weekly hours	38.9	38.8	39.1	40.2	40.0
Average hourly earnings	$2.95	$3.07	$3.21	$3.28	$3.40
Metal mining:					
Average weekly earnings	$111.97	$114.39	$122.80	$129.72	$129.02
Average weekly hours	37.7	36.9	37.9	39.1	38.4
Average hourly earnings	$2.97	$3.10	$3.24	$3.32	$3.36
Primary-metals processing:					
Average weekly earnings	$110.40	$116.40	$122.25	$117.08	$128.08
Average weekly hours	40.0	40.7	41.3	3.94	39.9
Average hourly earnings	$2.76	$2.86	$2.96	$2.97	$3.21

[1] Data for metal mining and primary-metals processing includes first 7 months of year only because of strike.

[2] Data for metal mining and primary-metals processing include last 9 months of year only because of strike.

Source: Montana State Employment Service, Montana Labor Market. Hours and earnings data exclude administrative and salaried personnel. Average weekly and hourly earnings include over time and other premium pay.

Table 6.—Employers, wage earners, and wages in mining

Fiscal year	Average number of employers	Average number of wage earners	Wages (thousands)	Average annual wage
1964	433	7,163	$45,225	$6,314
1965	421	7,456	49,048	6,578
1966	423	7,579	51,262	6,764
1967	414	7,305	52,572	7,197
1968	416	4,673	35,032	7,497

Source: Unemployment Compensation Commission of Montana, Montana Labor Market. Industries and employment covered under unemployment insurance laws of Montana.

Table 7.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal and peat	78	145	11	90	-------	9	100.01	2,634
Metal	4,253	186	793	6,343	7	125	20.81	9,357
Nonmetal	776	252	196	1,566	1	54	35.12	6,146
Sand and gravel	1,083	140	151	1,273	-------	25	19.64	399
Stone	375	226	85	678	-------	17	25.07	350
Total [1]	6,565	188	1,236	9,951	8	230	23.92	7,031
1968:[p]								
Coal and peat	75	146	11	87	-------	9	103.08	2,680
Metal	2,960	209	617	4,946	3	75	15.77	5,151
Nonmetal	765	256	195	1,572	2	51	33.71	8,924
Sand and gravel	595	172	102	822	-------	17	20.68	360
Stone	325	242	79	644	-------	7	10.87	118
Total [1]	4,725	213	1,005	8,072	5	159	20.32	4,970

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Table 8.—Office of Minerals Exploration contracts active during 1968

County and contractor	Commodity	Contract		
		Date	Total amount	Government participation (percent)
Granite: American Mining Co	Silver	July 31, 1968	$38,200	75
Cascade: Bennett, Carroll R	----do	Sept. 21, 1966	105,253	75
Jefferson: Development Operating Corp.	----do	Aug, 4, 1967	90,000	75
Madison: Janus Mining Co	Copper, gold, silver	Sept. 14, 1967	87,600	62.5

REVIEW BY MINERAL COMMODITIES

METALS

Aluminum.—Anaconda Aluminum Co. completed installation of the fourth and fifth potlines at its Columbia Falls plant. All 120 reduction cells in two new 1,080-foot-long potroom buildings were producing at rated capacity, which boosted the current annual production capacity to 175,000 tons. A new continuous rod-casting facility at the same location started operating in July.

Antimony.—Knute Kirkeberg shipped a small amount of antimony ore from a stockpile at the Stibnite mine in Sanders County.

Beryllium.—The Bureau of Mines published a 169-page report on beryllium deposits in the Northwest.[5] Among the areas included were the Alberton, Anaconda, Sula, Tobacco Root Mountain, and the Butte district. Beryllium was found in low-grade quartz veins and idocrase tactites. The study was done as part of a nationwide study of the national beryllium supply. Increased demand had been anticipated in supersonic aircraft, missiles, nuclear reactors, and space vehicles.

Cadmium.—The Anaconda Company recovered cadmium as a byproduct from electrolytic sludge at its Great Falls facility. According to the company's annual report to stockholders, output of 668 pounds of cadmium was exceptionally high due to treatment of high cadmium-bearing zinc concentrates.

Copper.—The nationwide copper strike, begun in July 1967, continued through

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[5] Pattee, Eldon C., Ronald M. Van Noy, and Robert D. Weldin. Beryllium Resources of Idaho, Washington, Montana, and Oregon. BuMines Rept. of Inv. 7148, 1968, 169 pp.

March 1968. Settlement of the strike in April saw a gradual return to production at The Anaconda Company's facilities at Butte, Anaconda, and Great Falls. As a result, production of copper increased 6 percent from the 1967 total to 69,480 tons, but was still 46 percent below the prestrike 1966 level.

Table 9.—Mine production of gold, silver, copper, lead, and zinc in terms of recoverable metals[1]

Year	Mines producing		Material sold or treated[2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1964	110	8	14,872	29,115	$1,019	5,290	$6,840
1965	121	11	15,634	22,772	797	5,207	6,733
1966	117	5	17,645	25,009	875	5,320	6,878
1967	62	3	9,093	9,786	343	2,066	3,203
1968	143	3	10,215	13,385	525	2,133	4,574
1862–1968	-------------		NA	17,800,752	407,537	861,715	661,540

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1964	103,806	$67,682	4,538	$1,189	29,059	$7,904	$84,633
1965	115,489	81,766	6,981	2,178	33,786	9,866	101,340
1966	128,061	92,639	4,409	1,333	29,120	8,445	110,171
1967	65,483	50,063	898	251	3,341	925	54,785
1968	69,480	58,151	1,870	494	3,778	1,020	64,764
1862–1968	8,340,062	2,998,551	946,897	150,796	2,841,124	550,013	4,768,436

NA Not available.

[1] Includes recoverable metal content of gravel washed (placer mines), ore milled, and ore, old slag, copper precipitates, and cleanings shipped to smelters during the calendar year indicated. Owing to rounding, individual items may not add to totals shown.

[2] Does not include gravel washed.

Table 10.—Mine production of gold, silver, copper, lead, and zinc in 1968, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Ore:							
Dry gold	9	225	142	313	-------	-------	--------
Dry gold-silver	14	12,383	1,622	39,460	[2] 16	[2] 75	[2] 122
Dry silver	80	55,006	988	299,508	109	497	270
Total	103	67,614	2,752	339,281	125	572	392
Copper	14	10,079,795	9,769	1,456,742	121,108	65	9
Lead	18	5,514	449	110,036	13	1,939	215
Lead-zinc	9	952	68	4,612	1	149	90
Zinc	3	14,551	-------	162,416	1	338	2,603
Total	44	10,100,812	10,286	1,733,806	121,124	2,490	2,917
Other lode material:							
Gold-silver old tailings	4	1,860	183	5,453	2	-------	--------
Silver old tailings	12	18,258	142	48,051	62	4	1
Copper precipitates	1	----------	-------	---------	17,647	-------	--------
Zinc slag	1	26,641	-------	5,980	-------	674	4,246
Total	18	46,759	325	59,484	17,712	678	4,247
Total lode material	143	10,215,185	13,363	2,132,571	138,960	3,740	7,556
Total placer	3	(3)	22	---------	-------	-------	--------
Grand total	146	10,215,185	13,385	2,132,571	138,960	3,740	7,556

[1] Detail will not necessarily add to total, because some mines produce more than one class of material.
[2] Includes small amount of copper, lead, and zinc from gold ore.
[3] 2,539 cubic yards.

Table 11.—Gold production at placer mines

Year	Mechanical and hydraulic methods [1]			Small-scale hand methods			Total [2]		
	Number of mines	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of mines	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of mines	Material treated (thousand cubic yards)	Gold (troy ounces)
1964	5	27	270	3	2	22	8	29	292
1965	7	93	161	4	1	10	11	94	171
1966	[3] 4	36	422	1	(4)	1	5	36	423
1967	[5] 3	15	141	------	------	------	3	15	141
1968	[6] 2	2	20	1	(4)	2	3	3	22

[1] Combined to avoid disclosing individual confidential data.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes 3 dragline dredges and one power rocker.
[4] Less than ½ unit.
[5] Includes 1 nonfloat washing plant, 1 hydraulic, and 1 power rocker.
[6] Includes 1 dragline dredge and 1 nonfloat washing plant.

Table 12.—Mine production of gold, silver, copper, lead, and zinc in 1968, by counties, in terms of recoverable metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
Beaverhead	13	----------	261	$10	45,906	$98
Broadwater	3	----------	W	W	13,489	29
Deer Lodge	5	----------	52	2	17,940	38
Fergus	1	----------	----------	----------	54	(1)
Granite	29	----------	334	13	224,916	482
Jefferson	37	1	1,060	42	74,498	160
Judith Basin	4	----------	1	(1)	1,911	4
Lewis and Clark	11	----------	336	13	21,029	45
Lincoln	1	----------	----------	----------	123	(1)
Madison	10	----------	W	W	W	W
Meagher	3	1	W	W	3,187	7
Mineral	4	----------	99	4	62,920	135
Park	2	----------	15	1	W	W
Powell	7	----------	46	2	855	2
Ravalli	1	----------	7	(1)	80,406	172
Silver Bow	6	----------	9,782	384	1,466,172	3,144
Undistributed [2]	6	1	1,392	55	119,165	256
Total [3]	143	3	13,385	525	2,132,571	4,574

County	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Beaverhead	5	$4	349	$92	55	$15	$220
Broadwater	W	W	279	74	20	5	110
Deer Lodge	3	2	--------	--------	--------	--------	43
Fergus	------	--------	(1)	(1)	--------	--------	(1)
Granite	27	22	164	43	1,277	345	906
Jefferson	17	14	136	36	127	34	286
Judith Basin	(1)	(1)	34	9	5	1	14
Lewis and Clark	4	3	451	119	2,166	585	765
Lincoln	------	--------	4	1	17	4	6
Madison	W	W	7	2	W	W	131
Meagher	(1)	(1)	W	W	W	W	31
Mineral	45	38	W	W	W	W	196
Park	2	2	--------	--------	--------	--------	W
Powell	W	W	5	1	W	W	8
Ravalli	1	1	186	49	30	8	231
Silver Bow	69,362	58,052	--------	--------	--------	--------	61,580
Undistributed [2]	13	11	254	67	83	22	235
Total [3]	69,480	58,151	1,870	494	3,778	1,020	64,763

W Withheld to avoid disclosing individual company confidential data.

[1] Less than ½ unit.

[2] Includes values and quantities that cannot be shown separately for Cascade, Flathead, Gallatin, Missoula, Sanders Counties, and items indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 13.—Mine production of gold, silver, copper, lead, and zinc, in 1968, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Amalgamation	2	2	-----	-----	-----
Concentration and smelting of concentrates	9,953	1,690,040	120,182	559	2,647
Total	9,955	1,690,042	120,182	559	2,647
Direct smelting:					
Ore	3,083	383,045	1,066	2,503	662
Tailings	325	53,504	65	4	1
Precipitates	-----	-----	17,647	-----	-----
Old slag	-----	5,980	-----	674	4,246
Total	3,408	442,529	18,778	3,181	4,909
Placer	22	-----	-----	-----	-----
Grand total	13,385	2,132,571	138,960	3,740	7,556

Table 14.—Mine production of gold, silver, copper, lead, and zinc in Silver Bow County, in terms of recoverable metals

Year	Mines producing		Material sold or treated [1] (thousand short tons)	Gold, lode and placer (troy ounces)	Silver, lode and placer (thousand troy ounces)
	Lode	Placer			
1964	10	-----	14,694	20,999	4,614
1965	8	2	15,462	18,420	4,790
1966	5	-----	17,503	21,608	4,864
1967	5	-----	9,041	8,339	1,856
1968	6	-----	10,089	9,782	1,466
1882–1968	-----	-----	[2] 357,817	2,441,948	646,502

Year	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value (thousands)
1964	103,600	2,678	20,239	$80,455
1965	115,279	4,594	25,629	97,378
1966	127,885	2,411	22,284	106,749
1967	65,448	64	816	53,450
1968	69,362	-----	-----	61,580
1882–1968	8,299,782	415,425	2,406,818	4,086,689

[1] Does not include gravel washed.
[2] Complete data not available: 1882–1904.

As production resumed in the State following the 8-month copper strike, firm prices for copper led to increasing production during the latter part of the year. The Anaconda open-pit operation at Butte set a 1-day production record of 306,944 tons of material removed, exceeding the current daily average by more than 25,000 tons. Included were 57,947 tons of ore, 69,430 tons of leach material, and 179,567 tons of waste. Copper production from The Anaconda Company Butte mines was 69,343 tons, up 6 percent from the 65,448 tons produced in 1967, but considerably lower than the 127,885 tons of copper produced in 1966. The Berkeley open pit accounted for 47,737 tons, up 20 percent from 1967. After the strike, production was resumed at the deep mines and concentrator in May. The Mountain Con and Stewart mines were placed on a curtailed, one-shift-per-day basis, and as a result, only 21,605 tons of copper came from underground mining in 1968 compared with 25,531 tons in 1967, and 48,054 tons in 1966. The Leonard mine was not reopened because of high operating costs.

The Anaconda Company continued its program of expansion and modernization at Butte and Anaconda. At the Berkeley Pit, an old heating plant was deactivated and dismantled to make way for pit expansion to the northwest. Expansion also continued eastward, and additional pumps were installed in the deeper portion of the pit to cope with a water problem. Construction of a new heating plant was started in the vicinity of the Kelley mine. The central underground pumping station on the 3900 level of the Kelley mine was completed. A new slime treatment plant addition to the Weed concentrator was activated. Construction of the No. 7 reverberatory furnace was completed at the Anaconda Reduction Works. The high-grade ore concentrator at Anaconda was closed as the Weed concentrator became fully equipped to handle all Butte copper ores.

Silver Ledge Mining Co. discovered copper-lead-silver ore in a crosscut at the Cape Nome mine near Clinton. Diamond drilling to 2,200 feet was undertaken at the Basin Comstock Mining Co. property, midway between Helena and Butte, to help delineate a newly found copper prospect. Kennecott Copper Corp. began a program of underground exploration at Spar Lake, 20 miles south of Troy, Lincoln County.

Gold.—An increase in the average market price of gold to $39.26 per ounce stimulated interest in gold production and exploration throughout the State and resulted in a 37-percent increase in gold production from 9,786 ounces in 1967 to 13,385 ounces in 1968. Approximately 73 percent of the State total originated in the Butte district as a byproduct of copper production. Placer output declined to only 22 ounces from three operations, compared with 141 ounces in 1967 and 423 ounces in 1966. Nine gold mines in Granite, Jefferson, Lewis, and Clark, Madison, and Powell Counties contributed to the total gold production. Additional gold was obtained from 14 gold-silver mines and four old tailings operations.

Pacific Mines, Inc., shipped gold and silver ore from an open-pit operation at the Pacific mine in the Alder-Virginia City region of Madison County. Three men produced and hauled 1,000 tons of ore per month to Alder for shipment to Helena and Butte. The K–D Co. explored and drilled on the Kendall-Barnes King properties in the North Moccasin Mountains.

Several potentially large low-grade gold deposits were investigated by the Bureau of Mines and U.S. Geological Survey with engineering and economic studies conducted under the Heavy Metals Program. The Golden Sunlight deposit in the Whitehall district of Jefferson County was evaluated; preliminary bulk sampling on a reportedly large low-grade gold deposit south of Anaconda was undertaken; and reconnaissance investigations were made in Broadwater, Mineral, and Powell Counties.

Iron Ore.—The total iron ore production in the State, except for 150 tons from the Nelson mines in Powell County, came from the Iron Cross mine of R & S Iron Co. near Radersburg. Production increased 20 percent from that in 1967 to 12,000 tons of ore. The ore, mined by open-pit methods, was used by the cement industry.

Lead.—Although less than half the total production in 1966, lead output more than doubled over the 1967 total to 1,870 tons. Byproduct lead output, affected by the copper strike, was still far below normal, but an increase in shipments from small lead-zinc-silver mines added to the total production. Lead production was reported from 81 operations throughout the State. The largest source was byproduct lead from the Anaconda slag fuming plant at East Helena which recovered 337 tons. The Maulden mine in Beaverhead County yielded 334 tons, the Jo Dandy mine in Broadwater County 277 tons, and the Sam Gaty-Franklin mine in Lewis and Clark County 93 tons of lead.

Manganese.—Continuing declines in demand for manganese concentrates resulted in reduction in the total amount of manganese shipped to approximately 6,700 tons of concentrates. No manganese ore was mined in the State during the year. Shipments from the stockpiles of The Anaconda Company and Taylor-Knapp Co. accounted for all the manganese production attributed to the State in 1968.

Nickel.—The Anaconda Company announced the discovery of nickel-bearing ore near Columbus in both Stillwater and Sweet Grass Counties. About 30 men were engaged in exploration efforts which included geological mapping, geophysical and geochemical work, diamond drilling, and sampling. The diamond-drilling program indicated nickel-copper values lying close to the surface where open-pit mining methods would be feasible.

Silver.—Output of silver increased 3 percent over the 1967 production to 2,133,000 ounces, but still continued to be 60 percent below the 1966 level, as the total byproduct silver output was reduced by the copper strike. Byproduct silver from the Butte mines of The Anaconda Company accounted for 1,449,087 ounces or 68 percent of the total silver produced. Also, 80 silver mines, 14 gold-silver mines, and 16 tailings operations contributed 392,472 ounces of silver to the total production. The mines were located in Beaverhead, Broadwater, Deer Lodge, Fergus, Flathead, Granite, Jefferson, Judith Basin, Lewis and Clark, Madison, Meagher, Mineral, Park, Powell, Ravalli, Sanders, and Silver Bow Counties.

The rising price of silver continued to arouse interest in locating and developing silver deposits in mining regions throughout the State.

Hecla Mining Co. explored for silver at the Granite-Bi-Metallic mine property near Philipsburg, but reportedly no important discoveries were made. Lucky Star Mining Co. completed 1,000 feet of exploratory diamond drilling at its Blue Creek silver-lead-zinc mine in Sanders County. Sierra Silver Mining Co. began diamond core drilling for silver at the Cadgie Taylor property, 2 miles east of Philipsburg.

Midnight Mines, Inc., purchased the Polaris mine near Dillon and shipped silver ore to the Anaconda smelter. The ore was stockpiled from surface development work on a newly discovered southerly extension of the Polaris vein. A new 600-foot adit was driven to within 400 feet of the vein at an intermediate level 200 feet below the surface.

Mascot Silver-Lead Mines, Inc., continued development work at its Meadow mine in Jefferson County. The shaft was sunk 65 feet to the 200 level where drifting on the vein 175 feet east and 500 feet west exposed two oreshoots.

Also in Jefferson County, Development Operating Corp. rehabilitated the shaft at the Elkhorn mine to the 550-foot level and did 1,600 feet of drifting, raising, and crosscutting under an Office of Minerals Exploration loan. New pumps, head frame, compressor, and hoist were installed, and the shaft was dewatered 700 feet. Exploration for silver and gold was undertaken at the Golden Curry and Klondyke mines.

A total of 700 feet of development drifts and crosscuts was driven on the 500 level of the Jo Dandy mine in Broadwater County. Silver Hill Co. started making small shipments of silver-copper ore from mines east of Alder in Madison County. The Curlew mine in Ravalli County was reopened, and production totaled over $100,000 in silver ore. Production of silver and lead continued from the Hand mine in the Argenta district.

Elcor Chemical Corp. of Midland, Tex., became operator of the Nancy Lee mine near Superior, Mineral County. A ball mill and jaw crusher were added to the concentrator at the mine. Spokane National Mines, Inc., operated its 130-ton mill at Bannack and continued production from the New Departure mine in Beaverhead County. The company installed a screening plant at the mine to upgrade dump material, which was then blended with the mine ore to obtain a satisfactory mill grade. Surface trenching and 12,000 feet of exploratory drilling were completed at the Florence mine in Cascade County.

Tungsten.—Minerals Engineering Co. reopened its Beaverhead County tungsten mill which had been idle for 7 years. Full production, employing 25 men, on a 24-hour basis was resumed at the plant in August. The mill, which was shut down for economic reasons, was rebuilt, and a chemical plant to produce ammonium paratungstate was added to the complex. A total of 27,950 tons of ore from the Calvert Creek mine, about 9 miles west of Wise River, was shipped to the mill for processing.

Tri-City Concrete Products shipped a small amount of tungsten concentrate from the Old Bonanza mine in Deer Lodge County.

Zinc.—The total output of the State, 3,778 tons, continued to be derived both as a byproduct of copper mining operations and from various small lead-zinc-silver operations. Byproduct zinc from the Anaconda slag fuming plant at East Helena was the largest source in the State, accounting for 56 percent of the total, as 2,123 tons was recovered from slag. Zinc production was reported from 66 operations throughout the State including three mines classified as principally zinc producers and nine mines classified as principally lead-zinc producers.

The Taylor-Knapp Co. Unit Area in Granite County was the largest zinc mining operation in the State producing 1,276 tons of zinc, 162 tons of lead, and 159,100 ounces of silver from 14,263 tons of ore.

NONMETALS

Cement.—The quantity and value of cement shipments increased 8 and 11 percent over the 1967 totals. Output was from the wet-process plant of Kaiser Cement & Gypsum Corp. at Montana City, Jefferson County, and from the dry-process plant of Ideal Cement Co. at Trident, Gallatin County. Destinations within the State received 59 percent of the cement sold. Shipments also were made to Colorado, Idaho, Minnesota, North Dakota, Oregon, Washington, and Wyoming. Of the total portland cement shipped, 43 percent was transported by rail and 57 percent by truck. The ratio of bulk to paper bag shipments was about 7:1. About 66 percent of the portland cement produced was distributed to firms manufacturing commercial concrete products, such as ready-mixed concrete companies (49 percent), concrete product manufacturers (8 percent), and building material dealers (9 percent). The remaining 34 percent was sold to highway (1 percent) and other contractors (26 percent), and to miscellaneous customers (7 percent).

Clays.—Output of miscellaneous clay and shale declined 35 percent, while bentonite production advanced 17 percent over the 1967 total. Miscellaneous clay and shale for making heavy clay products such as building brick was dug by Lewiston Brick & Tile Co. at Lewiston, Fergus County, and by Lovell Clay Products Co. at Billings, Yellowstone County. Shale from the Treasurelite pit near Great Falls, Cascade County, was expanded into lightweight aggregate by Treasurelite Division of Treasure State Industrial Products, Inc. Material from the Lockwood Flats pit near Billings, Yellowstone County, was expanded into lightweight aggregate by Concrete Products Co. Clay and shale used in manufacturing cement came from the Montana City pit, Jefferson County, of Kaiser Cement & Gypsum Corp., and from the Trident quarry, Gallatin County, of Ideal Cement Co.

Bentonite output continued to expand. National Lead Co. mined bentonite near Colony, Carter County, for use as oilwell drilling mud in the Rocky Mountain area. Hallett Minerals Co. recovered bentonite from a pit 2 miles west of Vananda, Rosebud County, and shipped the bentonite by railroad to Burnett, Minn., for milling into a product suitable for use as a binder in pelletizing taconite iron ore concentrate.

Construction began on a railroad spur 18 miles south of Glasgow, Valley County, to serve a bentonitic-clay processing plant proposed by Ashland Chemical Co. on the Brazil Creek Bentonite Co. bentonite placer claim. The deposit covered about 100,000 acres of surface area.

The Montana Bureau of Mines and Geology conducted field mapping and investigations of bentonite deposits in Montana.

Fluorspar.—Roberts Mining Co. mined fluorspar at the Crystal Mountain mine, Ravalli County, and trucked the ore 26 miles to Darby for processing at the company heavy-media separation plant. The steel industry was the largest consumer of the metallurgical-grade fluorspar.

Gypsum.—Output of gypsum mined increased 5 percent over the 1967 total. Gypsum from the Shoemaker underground mine near Heath, Fergus County, was calcined and marketed as ground gypsum by United States Gypsum Co.

Lime.—Lime production increased 25 percent over the 1967 total largely due to increased consumption for metallurgical use, water treatment, and sugar refining.

Lime for metallurgical use and for treatment of copper milling waste water came from The Anaconda Company operation at Anaconda, Deer Lodge County. Limestone for the plant was from the company's Browns quarry. Lime for use in sugar refining came from Holly Sugar Corp. operations at Hardin, Big Horn County, and Sidney, Richland County, and from the Great Western Sugar Co. plant at Billings, Yellowstone County.

Phosphate Rock.—The quantity of marketable phosphate rock production declined 33 percent, largely because of phasing out mining operations in Beaverhead, Silver

Bow, and Granite Counties. Mining was conducted in Granite and Powell Counties.

In Silver Bow County, the Stauffer Chemical Co., Industrial Chemical Division, elemental phosphorus plant at Silver Bow, operating in past years on rock from company-owned underground mines near Melrose (the East La Marche, Truste, and Canyon Creek mines, Beaverhead County; and the Maiden Rock mine, Silver Bow County), utilized rock from the company's Terteling holdings in Wooley Valley, near Soda Springs, Idaho. The cost of underground mining was a large factor in closing the Melrose properties, and equipment was removed from the mines early in the year. The higher grade ore from company strip-mining operations at Soda Springs did not have to be upgraded to meet plant requirements.

In Granite County near Hall, phosphate rock from the Douglas Creek mine was processed at the Cominco American, Inc., flotation concentrator from January through September. In October, operations were suspended at this locality. The company had operated the concentrator since 1963 upgrading material for shipment to fertilizer manufacturing plants at Trail and Kimberley, British Columbia, Canada.

In Powell County, phosphate rock of suitable grade for processing without further beneficiation went either directly to consumers in the Rocky Mountain States or to Trail, British Columbia, Canada, for manufacturing phosphate fertilizers by the Consolidated Mining & Smelting Co. of Canada, Ltd. Output in Powell County was by Cominco American, Inc., from the Anderson-Brock and Warm Springs mines, George Relyea from the Relyea mine, and A. G. Jackson from the Jackson mine.

Rocky Mountain Phosphates, Inc., operating in past years a phosphate-rock defluorinating plant at Garrison, continued to be involved in litigation over alleged responsibility by the company for air pollution.

Sand and Gravel.—Sand and gravel output declined 29 percent from the 1967 total because of lesser requirements by the State highway department in road construction and less tonnage used by the U.S. Army Corps of Engineers at the Libby Dam construction project.

Commercial sand and gravel firms operated 42 plants (25 stationary and 17 portable) in producing 28 percent of the State output. About one-half or 49 percent of

Table 15.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967 Quantity	1967 Value	1968 Quantity	1968 Value
Commercial operations:				
Building	810	$1,192	788	$1,284
Road material	1,558	1,318	1,210	1,128
Fill	195	166	222	178
Other [1]	231	309	212	296
Total	2,794	2,985	2,432	2,886
Government-and-contractor operations:				
Building	6	8	13	5
Road material	8,403	7,127	4,971	3,230
Fill	1,102	492	473	343
Other [1]	34	43	873	1,290
Total	9,545	7,670	6,330	4,868
All operations:				
Building	816	1,200	801	1,289
Road material	9,961	8,445	6,181	4,358
Fill	1,297	658	695	521
Other [1]	265	352	1,085	1,586
Grand total	12,339	10,655	8,762	7,754

[1] Sand and gravel used for railroad ballast and miscellaneous and unspecified purposes.

the State's commercial output came from operations producing less than 200,000 tons annually. Government-and-contractor production (largely for roads and dam construction by Federal, State, and local government agencies) came from 35 plants (two stationary and 33 portable) and comprised 72 percent of the total production.

Sand and gravel was produced in 49 counties. Output exceeded 1 million tons in Yellowstone County. The use distribution of sand and gravel output was road material, 71 percent; building, 9 percent; and miscellaneous uses, including fill and railroad ballast, 20 percent.

Stone.—Output of stone declined 31 percent largely because of less usage at State highway department projects. Stone was produced in 31 counties, and output exceeded 1 million tons in Granite County.

Basalt, dolomite, granite, limestone, marble, miscellaneous stone (unclassified as to type), quartzite, and sandstone were produced. The basalt, dolomite, granite, and miscellaneous stone, from operations at 39 quarries, were used largely in road construction (1.4 million tons); however, some was used as riprap and rockfill (553,000 tons) in dam construction and as railroad ballast.

Limestone output, from eight operations at eight quarries, totaling 1.1 million tons valued at $1.3 million, was used for manufacturing cement, for making lime, for sugar refining, and for metallurgical purposes. Some was used in road and dam construction. Limestone was produced in Big Horn, Broadwater, Carbon, Deer Lodge, Gallatin, and Jefferson Counties.

A high-calcium limestone deposit in western Montana was described.[6]

Marble output came from three operations at six quarries in Carbon, Madison, and Park Counties. Dimension marble was used for building purposes and crushed and broken marble was used in concrete, marble whiting, roofing granules, and terrazzo. Some crushed and sized material was used for poultry grit, and for manufacturing calcium carbide and paper.

Sandstone, quartz, and quartzite for building purposes as dimension stone, for construction purposes as riprap and jetty stone, and for use as industrial silica totaled 219,000 tons valued at $504,000. It came from seven operations at 12 quarries in Beaverhead, Cascade, Dawson, Deer Lodge, Gallatin, Jefferson, Ravalli, and Yellowstone Counties. The crushed and sized industrial silica products were used in manufacturing abrasives, cement, ferrosilicon, and for metallurgical purposes.

Sulfur.—Production of high-purity elemental sulfur from oil refinery waste gases by Montana Sulphur & Chemical Co. increased compared with the 1967 total. Oil refinery waste gases for the sulfur recovery unit continued to be supplied by Continental Oil Co. and Humble Oil & Refinery Co. operations at Billings. As an addition to the existing facility at Billings for producing elemental sulfur, the company installed a 20-ton-per-day high-purity hydrogen sulfide recovery system.

Farmers Union Central Exchange, Inc., began installing a sulfur recovery system that was contingent upon byproduct hydrogen sulfide gas received from its oil-refining operation at Laurel, Yellowstone County. The 28-ton-per-day elemental sulfur recovery unit was expected to be in service by March 1969.

Talc.—The quantity of talc produced declined 12 percent compared with the 1967 output. The talc, mined by two companies, came from one mine in Beaverhead County and from four mines in Madison County. It was ground and sized at plants in Beaverhead and Gallatin Counties. Some was shipped for processing to a plant at Grand Island, Nebr.

Chas. Pfizer & Co., Inc., Minerals, Pigments, and Metals Division, mined talc at the Smith-Dillon-Crown mine on Axes Creek 11 miles southeast of Dillon, Beaverhead County. The material was trucked about 10 miles to a company grinding mill at Barratts for processing. Talc from the company Regal-Keystone and Treasure State mines in Madison County also was ground at the Barratts mill.

United Sierra Division, Cyprus Mines Corp., mined talc at the Yellowstone mine in Johnny Gulch, 15 miles south of Cameron, Madison County. After hand sorting at the mine, the upgraded material was trucked 75 miles to a company grinding plant at Three Forks, Gallatin County. Some of the talc was trucked 45 miles from the mine to a Northern Pacific Railway siding at Norris and transshipped to a company grinding plant at Grand Island, Nebr.

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[6] Landreth, John O. High-Calcium Limestone Deposit in the Rattler Gulch Area, Granite County, Montana. Montana Bur. Mines and Geol., Spec. Pub. 44, January 1968, 10 pp.

The use distribution of talc by industry was paper, 30 percent; paint, 30 percent; ceramics, 24 percent; and exports and miscellaneous uses including insecticides and rice polishing, 16 percent.

Vermiculite.—Crude vermiculite output increased 18 percent above the 1967 total. The Zonolite Division, W. R. Grace & Co., open-pit operation near Libby, Lincoln County, continued to be the principal source of vermiculite in the United States. Crude ore was screened, cleaned, and sized at a mill adjacent to the mine site, and the concentrate was shipped largely out of State for processing at both company and other custom exfoliating plants. Some of the milled material was exfoliated by a company at Great Falls, Cascade County.

MINERAL FUELS

Coal.—Output of bituminous coal and lignite increased 40 percent above the 371,294 tons produced in 1967 largely because of greater requirements for coal at steam-electric generating plants. There were 11 active mines in six counties, seven underground and four open-pit operations. Bituminous coal was produced at nine mines, seven underground and two open-pit, in four counties. The principal source of bituminous coal was the Colstrip mine, Rosebud County, followed by output from six underground mines in Musselshell County and an open pit in Big Horn County and an underground mine in Blaine County.

Western Energy Co., a subsidiary of Montana Power Co., mined bituminous coal at Colstrip for the Montana Power Co. coal-fired steam-electric plant at Billings which began operating in September. Coal was hauled in specially designed gondola cars 100 miles from Colstrip to Billings by two unit trains capable of transporting 6,000 tons per week.

Lignite was produced at one open pit each in Powder River and Richland Counties. The Knife River Coal Mining Co. Savage mine at Sidney, Richland County, continued to be the principal source of lignite. Output was used as a fuel in the Montana-Dakota Utilities Co. coal-fired steam-electric generating plant at Sidney.

Western Energy Co. arranged to crush and load coal for Peabody Coal Co. which contracted to provide Minnesota Power & Light Co. 2 million tons of coal annually from a Colstrip operation by 1973. The coal, to be used in a coal-fired steam-generating plant at Cohasset, Minn., was to be transported from Colstrip 850 miles to Cohasset on three unit trains each having 92 gondola cars.

Results of Montana coal analysis were published.[7]

Economic mining was outlined for strippable coal deposits in Montana.[8]

Petroleum and Natural Gas.—Recovery of crude petroleum was an alltime high totaling 48.5 million barrels valued at $124.5 million, and represented over 55 percent of the Montana mineral production value.

The Bell Creek field discovered in the Powder River basin, Powder River County,

Table 16.—Coal (bituminous) production[1] in 1968, by counties

(Thousand short tons and thousand dollars)

County	Number of mines by type of operation		Production total	
	Underground	Strip	Quantity	Value
Big Horn	-------	1	1,613	$12,098
Blaine, Musselshell, Rosebud [2]	7	1	187,088	577,057
Total	7	2	188,701	589,155

[1] Excludes mines producing less than 1,000 short tons.
[2] Combined to avoid disclosing individual company confidential data.

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[7] Gilmour, Ernest H., and Gardar G. Dahl, Jr. Montana Coal Analyses. Montana Bur. of Mines and Geol., Spec. Pub. 43, November 1967, 21 pp.

[8] Matson, Robert E., Gardar G. Dahl, Jr., and John W. Blumer. Strippable Coal Deposits on State Land, Powder River County, Montana. Montana Bur. Mines and Geol., Bull. 69, August 1968, 81 pp.

in 1967, accounted for most of the production increase with an alltime annual field record output in Montana of over 16.6 million barrels. Over 34 percent of the crude oil produced in the State came from the Bell Creek field, which was described as the biggest oil production area in the Rocky Mountains.[9] Crude oil was pumped from the Muddy sand formation at depths ranging from 4,300 to 4,700 feet, and some wells at Bell Creek were drilled in less than 26 hours. Area of the field extended over 100 square miles, and crude oil reserves were estimated at over 200 million barrels. A $2.5 million natural-gas processing plant was constructed at Bell Creek to process 15 million cubic feet per day of gas.

Another 32 percent of the State's recovered crude oil came from five other fields—the Pine (3.8 million barrels), Cabin Creek (3.5 million barrels), and Pennel (1.7 million barrels) fields in the Williston Basin, the Cut Bank (3.8 million barrels) field in north-central Montana, and the Elk Basin (2.6 million barrels) field in south-central Montana.

Marketed production of natural gas decreased 25 percent to 19.3 billion cubic feet (Bcf), and withdrawal of natural gas continued to be highest in the Cut Bank-Reagan field with output totaling 7.8 Bcf. Cedar Creek field ranked second with production of 4.8 Bcf, and Keith Block field, with output totaling 3.4 Bcf, was third. Fields exceeding 1 Bcf of natural gas withdrawals were Big Coulee, Bowdoin, Cabin Creek, Elk Basin, Lake Basin, Utopia, and Whitlash. Exploratory drilling efforts continued in the Eagle sand formation at Tiger Ridge field, and by the end of the year, there were 33 shut-in gas wells on the north flank of the Bearpaw Moun-

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[9] Bleakley, Bruce. Bell Creek: Newest U.S. Oil Giant. Oil and Gas J., v. 66, No. 19, May 6, 1968, pp. 80–82.
Mitchell, Young O. Bell Creek Nears First Place in Rockies. Oil and Gas J., v. 66, No. 16, Apr. 15, 1968, pp. 34–36.

Table 17.—Oil and gas wells drilled in 1968, by counties

County	Exploratory wells			Proved field wells			Total	
	Dry	Oil	Gas	Dry	Oil	Gas	Wells	Footage
Big Horn	17	------	------	------	1	------	18	112,170
Blaine	11	1	3	2	1	1	19	59,902
Carbon	1	------	------	1	6	------	8	49,135
Carter	98	------	------	1	4	------	103	420,491
Chouteau	14	------	------	------	------	------	14	29,351
Custer	51	------	------	------	------	------	51	278,386
Daniels	------	------	------	------	1	------	1	7,590
Dawson	3	------	------	------	------	------	3	15,824
Fallon	3	------	------	1	3	------	7	47,600
Fergus	2	------	------	------	------	------	2	5,400
Garfield	2	------	------	1	1	------	4	11,883
Glacier	1	2	2	5	3	------	13	38,923
Golden Valley	1	------	------	------	------	------	1	1,705
Hill	8	------	3	1	------	5	17	33,151
Judith Basin	3	------	------	------	------	------	3	4,762
Liberty	13	1	2	8	11	2	37	101,574
McCone	8	------	------	------	------	------	8	44,381
Musselshell	10	------	------	6	8	------	24	110,664
Petroleum	------	------	------	4	1	------	5	14,099
Phillips	4	------	------	------	------	------	4	14,248
Pondera	4	1	------	------	10	------	15	43,271
Powder River	133	2	------	39	225	3	402	2,032,402
Prairie	16	------	------	1	------	------	17	108,389
Richland	4	2	------	2	12	------	20	255,086
Roosevelt	3	------	------	3	------	------	6	46,569
Rosebud	45	1	------	3	4	------	53	291,511
Sheridan	7	2	------	7	5	------	21	185,186
Stillwater	3	------	------	------	------	------	3	9,957
Teton	4	------	------	------	------	------	4	9,132
Toole	29	3	3	4	4	3	46	102,149
Treasure	1	------	------	------	------	------	1	6,394
Valley	7	------	------	------	------	------	7	35,607
Wibaux	1	------	------	------	------	------	1	7,432
Yellowstone	2	------	------	------	------	------	2	9,437
Total	509	15	13	89	300	14	940	4,538,711

Source: Oil and Gas Conservation Commission of the State of Montana.

tains, Blaine County, in north-central Montana. High Crest Oil Co., Inc., and Montana Power Co. negotiated a contract for removing natural gas from Tiger Ridge field, discovered by High Crest in 1967. Montana Power Co. announced plans for constructing a $6 million pipeline from Tiger Ridge to Montana Power Co. facilities.

There were 940 wells drilled for oil and gas. Exploratory drilling totaling 537 wells resulted in 15 oil discoveries, 13 gas wells, and 509 dry holes. Development drilling totaling 403 wells resulted in 300 oil producers, 14 gas wells, and 89 dry holes. Exploratory and development drilling continued to be highest in Powder River County in the vicinity of Bell Creek field where drilling totaling 402 wells resulted in 227 oil producers, three gas wells, and 172 dry holes. The well depth in Bell Creek field continued to average less than 5,000 feet.

Nine refineries processed 41 million barrels of crude oil. Montana wells supplied 24 percent of the crude oil refined; 57 percent came from Wyoming, and 19 percent from Canadian wells.

There were 46 active secondary recovery projects; 43 were waterflooding, and three were gas injection projects. Seven waterflood projects were started.

Table 18.—Principal producers

Commodity and company	Address	Type of activity	County
METALS			
Aluminum: Anaconda Aluminum Co.	Columbia Falls, Mont.	Plant	Flathead.
	Great Falls, Mont.	Rolling mill	Cascade.
Antimony: Knute Kirkeberg	Thompson Falls, Mont.	Mine	Sanders.
Copper: The Anaconda Co	Anaconda, Mont.	Smelter	Deer Lodge.
	Great Falls, Mont.	Refinery, rolling mill.	Cascade.
	Butte, Mont.	Mine, concentrator, precipitating plant.	Silver Bow.
Gold:			
Beaver Creek Placers	Belt, Mont.	Placer	Meagher.
Maurice R. Haigh	Three Forks, Mont.	do	Jefferson.
J. T. LaChambre	Huson, Mont.	do	Missoula.
Pacific Mines, Inc	Virginia City, Mont.	Mine	Madison.
Iron ore:			
Harold G. Nelson, Sr	Greenough, Mont.	do	Powell.
R & S Iron Co	Radersburg, Mont.	do	Broadwater.
Lead-zinc:			
American Smelting and Refining Co.	East Helena, Mont.	Smelter	Lewis and Clark.
The Anaconda Co		Slag fuming plant	Do.
	Great Falls, Mont.	Zinc plant	Cascade.
John H. Byrd	Anaconda, Mont.	Mine	Lewis and Clark.
Dee Mines	Victor, Mont.	do	Ravalli.
John Hand	Dillon, Mont.	do	Beaverhead.
Hoco, Inc	White Sulfur Springs, Mont.	do	Meagher.
Kinley Enterprises	Butte, Mont.	do	Broadwater.
Nancy Lee Mines, Inc	Superior, Mont.	Mine and mill	Mineral.
Taylor-Knapp Co	Philipsburg, Mont.	do	Granite.
Silver:			
Frank Antonioli, Joe Metesh	Butte, Mont.	Mine	Silver Bow.
Delbert Bullock, Delbert Bragg.	Basin, Mont.	do	Jefferson.
Champion Silver Mining Co	Butte, Mont.	do	Deer Lodge.
Contact Mining Co	Philipsburg, Mont.	do	Granite.
Flathead Mines, Inc	Kalispell, Mont.	do	Flathead.
Liverpool Mining Co	Clancy, Mont.	do	Jefferson.
E. J. Schmaus	Wise River, Mont.	do	Beaverhead.
Spokane National Mines, Inc	Spokane, Wash.	Mine and mill	Beaverhead.
Dick Tunstill	Philipsburg, Mont.	Mine	Granite.
Ben Walkup		do	Do.
Tungsten:			
Minerals Engineering Co	Glen, Mont.	Mine and mill	Beaverhead.
Tri-City Concrete Products	Anaconda, Mont.	Mine	Deer Lodge.
NONMETALS			
Cement:			
Ideal Cement Co	Trident, Mont.	Plant	Gallatin.
Kaiser Cement & Gypsum Corp.	Montana City, Mont.	do	Jefferson.
Clay:			
Concrete Products Co	Billings, Mont.	Pit and plant	Yellowstone.
Hallett Minerals	Vananda, Mont.	Pit	Rosebud.

See footnote at end of table.

Table 18.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
NONMETALS—Continued			
Clay—Continued			
Ideal Cement Co	Trident, Mont	Pit and plant	Gallatin.
Kaiser Cement & Gypsum Corp.	Montana City, Mont	Pit	Jefferson.
Lewistown Brick & Tile Co	Lewistown, Mont	Pit and plant	Fergus.
Lovell Clay Products Co	Billings, Mont	do	Yellowstone.
National Lead Co	Colony, Mont	do	Carter.
Treasurelite, Division of Treasure State Industrial Products, Inc.	Great Falls, Mont	do	Cascade.
Fluorspar: Roberts Mining Co	Darby, Mont	Mine and plant	Ravalli.
Gypsum:			
Bridger Gypsum Co	Billings, Mont	Mine	Carbon.
United States Gypsum Co	Lewistown, Mont	do	Fergus.
Lime: The Anaconda Co	Butte, Mont	Plant	Deer Lodge.
Phosphate rock:			
Cominco American, Inc	Garrison, Mont	Mine and plant	Granite and Powell.
Eich & Lee	Elliston, Mont	Mine	Powell.
A. G. Jackson		do	Do.
Relyea Mines	Garrison, Mont	do	Do.
Stauffer Chemical Co	380 Madison Ave. New York, New York	Plant	Silver Bow.
Sand and gravel:			
Billings Sand & Gravel	Billings, Mont	Pit and plant	Yellowstone.
Cave Construction, Inc	Great Falls, Mont	do	Cascade.
Empire Sand & Gravel	Billings, Mont	do	Yellowstone.
Engebretson Gravel, Inc	Kalispell, Mont	do	Flathead.
McElroy & Wilken, Inc		do	Do.
Midland Materials Co	Billings, Mont	do	Yellowstone.
Oscar J. Mortenson	Cascade, Mont	do	Cascade.
Pioneer Ready-Mix	Bozeman, Mont	do	Gallatin.
Richardson Construction Co	Miles City, Mont	do	Various.
Stone:			
The Anaconda Company	Anaconda, Mont	Quarry	Deer Lodge.
R. A. Heintz Construction Co	Libby, Mont	do	Lincoln.
Ideal Cement Co	Trident, Mont	do	Gallatin.
Kaiser Cement & Gypsum Corp.	Montana City, Mont	do	Jefferson.
Washington Construction Co	Missoula, Mont	do	Granite.
Sulfur: Montana Sulphur & Chemical Co.	Billings, Mont	Plant	Yellowstone.
Talc and soapstone:			
Chas. Pfizer & Co., Inc	Dillon, Mont	Mine and plant	Beaverhead.
		Mine	Madison.
United Sierra Division of Cyprus Mines Corp.	Cameron, Mont	do	Do.
	Three Forks, Mont	Plant	Gallatin.
Vermiculite: W. R. Grace & Co., Zonolite Division.	62 Whittemore Ave. Cambridge, Mass.	Pit and plant	Lincoln.
Exfoliated vermiculite: Robinson Insulation Co.	Great Falls, Mont	Plant	Cascade.
MINERAL FUELS			
Coal:			
Acme Coal Mine	Coalridge, Mont	Mine	Sheridan.
Divide Coal Mining Co	Roundup, Mont	do	Musselshell.
Janskovitch Bros	Bearcreek, Mont	do	Carbon.
Johnnie's Coal Mine	Roundup, Mont	do	Musselshell.
Knife River Coal Mining Co	Savage, Mont	do	Richland.
Paul Megal	Roundup, Mont	do	Musselshell.
Milk River Coal Mine Co	Chinook, Mont	do	Blaine.
Nies Coal Co	Roundup, Mont	do	Musselshell.
Rosebud Coal Sales Co	Decker, Mont	do	Big Horn.
John H. Schoonover	Ashland, Mont	do	Powder River.
Square Deal Coal Co	Roundup, Mont	do	Musselshell.
Western Coal Co		do	Do.
Western Energy Co	Butte, Mont	do	Rosebud.
Natural gas processing:			
Union Oil Co.[1]	Cut Bank, Mont	Plant	Glacier.
Union Texas Natural Gasoline Corp.[1]	Baker, Mont	do	Wibaux and Fallon.
Peat: Martin's Peat & Potting Soils	Swan Lake, Mont	Bog	Lake.
Petroleum refining:			
Big West Oil Co	Kevin, Mont	Refinery	Toole.
Continental Oil Co	Billings, Mont	do	Yellowstone.
Diamond Asphalt Co	Chinook, Mont	do	Blaine.
Farmers Union Central Exchange, Inc.	Laurel, Mont	do	Yellowstone.
Humble Oil & Refining Co	Billings, Mont	do	Do.

See footnote at end of table.

Table 18.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
MINERAL FUELS—Continued			
Petroleum refining—Continued			
Jet Fuel Refinery	Mosby, Mont	Refinery	Garfield.
Phillips Petroleum Co	Great Falls, Mont	do	Cascade.
Tesoro Petroleum Co	Wolf Point, Mont	do	Roosevelt.
Union Oil Co	Cut Bank, Mont	do	Glacier.

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[1] Liquefied petroleum gases, natural gasoline, and other products.

The Mineral Industry of Nebraska

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Nebraska Geological Survey for collecting information on all minerals except fuels.

By Arthur E. Falvey [1] and William C. Henkes [2]

Valued at $74.8 million in 1968, mineral production in Nebraska was 6 percent greater than that in 1967. The value of nonmetals increased 14 percent, but that of fuels decreased slightly. Nonmetals amounted to $35.3 million (47 percent) of the total value of mineral production in 1968, compared with $30.8 million (44 percent) in 1967. Fuels were valued at $39.6 million, a decrease of $500,000. There were no metallic minerals produced in the State in 1968. The overall $4.4 million increase in value of nonmetals was due principally to increased demands for cement and sand and gravel. Lime increased $233,000 in value, and clay increased $64,000; stone and pumice decreased in value $48,000 and $2,000, respectively.

Government Programs.—Of the State's designated 479.5 miles for the National System of Interstate and Defense Highways, 373.0 miles were open to traffic at yearend, an addition of 38.6 miles to that completed on December 31, 1967.[3]

Table 1.—Mineral production in Nebraska[1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Clays ---- thousand short tons	126	$142	148	$206
Gem stones	NA	5	NA	4
Lime ---- thousand short tons	W	W	28	W
Natural gas (marketed) ---- million cubic feet	8,453	1,454	8,129	1,423
Natural gas liquids:				
LP gases ---- thousand 42-gallon barrels	494	1,223	451	911
Natural gasoline and cycle products ---- do	186	578	158	456
Petroleum (crude) ---- do	13,373	36,775	13,183	36,781
Sand and gravel ---- thousand short tons	11,739	10,878	13,013	13,175
Stone ---- do	4,846	7,483	4,416	7,435
Value of items that cannot be disclosed: Cement, pumice, and values indicated by symbol W	XX	12,330	XX	14,446
Total	XX	70,868	XX	74,837
Total 1957–59 constant dollars	XX	r 68,432	XX	p 71,894

p Preliminary. r Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

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[1] Mining engineer, Bureau of Mines, Denver, Colo.

[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

[3] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1968. Press Release FHWA-295, Feb. 24, 1969.

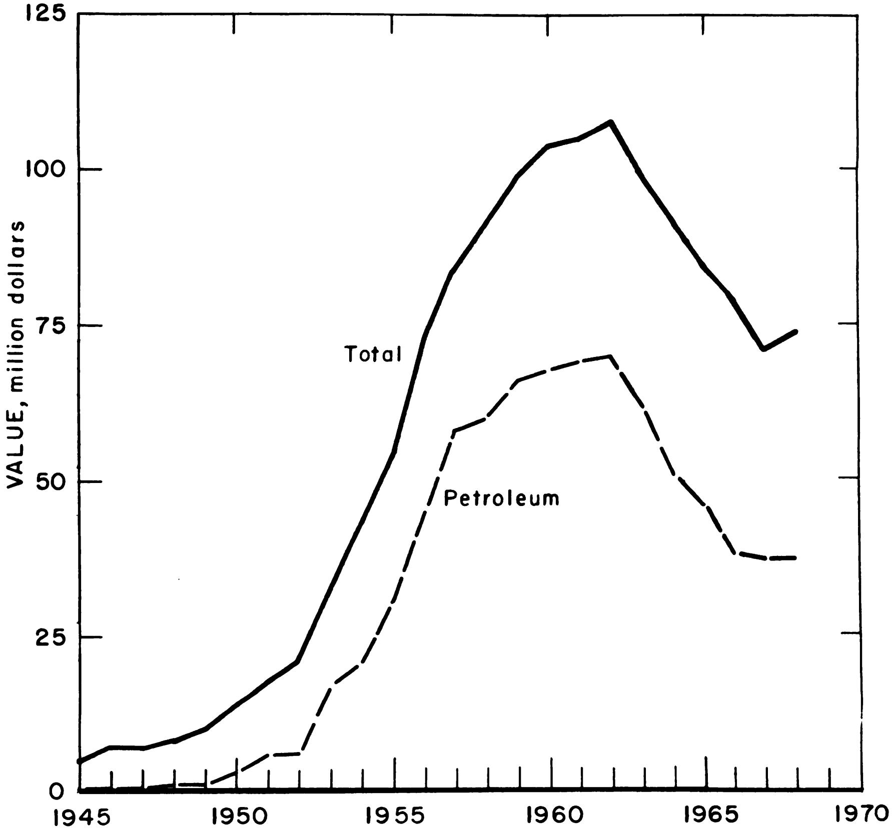

Figure 1.—Value of petroleum and total value of mineral production in Nebraska.

Contracts awarded for highway construction in Nebraska totaled $38.6 million, an 18 percent increase above the 1967 figure.[4]

Amounts expended on waterways during 1968 by the U.S. Army Corps of Engineers were as follows:

Flood protection, Stage II, Elkhorn River Basin, Norfolk	$822,100
Channel stabilization, Phase II, Gering Valley	$896,500
Channel improvements, Little Papillion Creek, and recreation facilities, Dodge Park, Omaha	$811,600
Missouri River Levee R–613 and recreation facilities near Bellevue	$1,313,000
Emergency levee repairs, Platte River, Cedar Creek	$37,900
Remedial work, flood protection, Elkhorn River Basin, Waterloo	$12,100
Bank stabilization, Missouri River, South Sioux City to Rulo	$905,700
Total	$4,298,900

The greater construction activity increased the demand for cement, sand and gravel, and stone.

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[4] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1969 . . . and Budgets for Maintenance: Highway Award Plans Up 47% as '69 Federal-Aid Work Soars. V. 182, No. 14, Apr. 3, 1969, pp. 52–53.

Table 2.—Value of mineral production in Nebraska, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Adams	$43	$87	Sand and gravel.
Antelope	37	81	Do.
Banner	6,935	5,692	Petroleum, natural gas, sand and gravel.
Blaine	7	(2)	Sand and gravel.
Boone	W	W	Do.
Box Butte	1	--------	
Boyd	14	31	Sand and gravel.
Brown	164	W	Do.
Buffalo	308	289	Do.
Butler	123	289	Do.
Cass	16,116	16,316	Cement, stone, sand and gravel, clays.
Cedar	137	W	Sand and gravel.
Chase	11	22	Do.
Cherry	6	W	Do.
Cheyenne	9,267	7,618	Petroleum, natural gas, LP gases, natural gasoline, sand and gravel.
Clay	109	W	Sand and gravel.
Colfax	115	92	Do.
Cuming	245	541	Do.
Custer	141	92	Do.
Dakota	48	23	Do.
Dawes	11	6	Stone.
Dawson	246	250	Sand and gravel.
Deuel	256	279	Natural gas, sand and gravel.
Dixon	W	112	Sand and gravel, stone.
Dodge	617	622	Sand and gravel.
Douglas	1,398	1,804	Sand and gravel, stone, clays.
Dundy	20	9	Petroleum, sand and gravel.
Fillmore	37	102	Sand and gravel.
Franklin	72	54	Do.
Frontier	229	234	Petroleum, sand and gravel, natural gas.
Furnas	56	68	Sand and gravel, stone, petroleum.
Gage	238	377	Sand and gravel, stone.
Garden	38	37	Petroleum, sand and gravel.
Garfield	5	6	Sand and gravel.
Hall	912	997	Do.
Hamilton	--------	W	Do.
Harlan	86	W	Petroleum, sand and gravel.
Hayes	W	W	Sand and gravel, petroleum.
Hitchcock	820	766	Petroleum, sand and gravel.
Holt	166	94	Sand and gravel.
Hooker	--------	8	Do.
Howard	W	70	Do.
Jefferson	W	W	Sand and gravel, clays.
Johnson	5	W	Stone, sand and gravel.
Kearney	72	91	Sand and gravel.
Keith	248	747	Do.
Keya Paha	--------	9	Do.
Kimball	10,672	10,086	Petroleum, LP gases, natural gasoline, natural gas, sand and gravel.
Knox	79	80	Sand and gravel.
Lancaster	258	254	Stone, sand and gravel, clays.
Lincoln	W	W	Sand and gravel, petroleum, pumice.
Logan	29	--------	
Loup	10	21	Sand and gravel.
Madison	311	413	Do.
McPherson	W	(2)	Do.
Merrick	W	W	Do.
Morrill	1,830	1,709	Petroleum, sand and gravel, lime, natural gas.
Nance	W	W	Sand and gravel.
Nemaha	104	W	Stone, sand and gravel.
Nuckolls	W	W	Cement, sand and gravel, stone.
Otoe	W	163	Clays and stone.
Pawnee	194	94	Stone and sand and gravel.
Perkins	18	29	Sand and gravel.
Phelps	W	W	Do.
Pierce	134	W	Do.
Platte	751	901	Do.
Polk	W	W	Do.
Red Willow	8,826	12,244	Petroleum and sand and gravel.
Richardson	366	W	Petroleum, stone, sand and gravel.
Rock	6	12	Sand and gravel.
Saline	208	W	Sand and gravel and stone.
Sarpy	831	724	Stone and sand and gravel.
Saunders	750	723	Sand and gravel.
Scotts Bluff	1,976	1,866	Petroleum, lime, sand and gravel, natural gas.
Seward	W	W	Stone and sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Nebraska, by counties[1]—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Sheridan	--------	$13	Sand and gravel.
Sherman	$2	--------	
Sioux	42	6	Sand and gravel.
Stanton	W	W	Do.
Thayer	160	W	Sand and gravel and stone.
Thomas	27	21	Sand and gravel.
Thurston	2	--------	
Valley	44	81	Sand and gravel.
Washington	W	W	Stone.
Wayne	--------	1	Sand and gravel.
Webster	48	45	Do.
Wheeler	9	17	Do.
York	102	671	Do.
Undistributed [3]	3,719	6,749	
Total [4]	70,868	74,837	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Arthur, Burt, Gosper, Grant, and Greeley.

[2] Less than ½ unit.

[3] Includes gem stones that cannot be assigned to specific counties, and values indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Nebraska business activity

	1967	1968 p	Change (percent)
Employment and labor force, annual average:			
Total labor force .... thousands	636.7	643.6	+1.1
Total employment .... do	620.6	627.4	+1.1
Total unemployment .... do	15.8	15.9	+.6
Total agricultural employment .... do	114.2	110.0	−3.7
Total nonagricultural employment .... do	r 506.4	517.4	+2.2
Mining .... do	1.7	1.6	−5.9
Contract construction .... do	23.3	24.3	+4.3
Manufacturing .... do	80.2	82.6	+3.0
Trade .... do	109.0	112.2	+2.9
Service and miscellaneous .... do	72.8	75.0	+3.0
Government .... do	93.1	96.2	+3.3
All other .... do	126.3	125.5	−.6
Personal income:			
Total .... do	r $4,422	$4,634	+4.3
Per capita	r $3,081	$3,220	+4.5
Construction activity:			
Cement shipments to and within the State thousand 376-pound barrels	4,450.8	4,427.1	−.5
Highway construction contracts awarded .... millions	$32.8	$38.6	+17.7
Mineral production .... do	$70.9	$74.8	+5.5

p Preliminary. r Revised.

Sources: Department of Economic Development, State of Nebraska, Lincoln, Nebr. Engineering News-Record, v. 182, No. 14, Apr. 3, 1969, pp. 52–53. Survey of Current Business, v. 49, No. 4, April 1969, p. 17.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967								
Nonmetal	44	231	10	82	-------	2	24.49	147
Sand and gravel	879	203	178	1,703	1	10	6.46	3,835
Stone	526	266	140	1,167	-------	20	17.14	444
Total [1]	1,449	227	328	2,951	1	32	11.18	2,392
1968 p								
Nonmetal	15	209	3	24	-------	-------	-------	-------
Sand and gravel	830	211	176	1,651	1	24	15.15	4,195
Stone	480	281	134	1,104	-------	13	11.77	606
Total	1,325	236	313	2,779	1	37	13.67	2,732

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Natural Gas.—Marketed natural gas continued to decline as reservoirs were further depleted and new discoveries failed to keep pace with market demand. The 1968 decline, however, was not as great as that of 1967—3.8 percent compared with 17 percent in 1967. According to the State Oil and Gas Conservation Commission 5.6 billion cubic feet of dry gas and 3.6 billion cubic feet of casinghead gas were produced during the year. The dry gas was produced in Cheyenne, Deuel, and Kimball Counties; the casinghead gas was from Banner, Cheyenne, Frontier, Kimball, Morrill, and Scotts Bluff Counties. At yearend 36 wells were producing dry gas, and five were shut in. With an output of 5.5 billion cubic feet, 60.4 percent of the total, Cheyenne County was the principal source of natural gas.

The American Petroleum Institute (API) and the American Gas Association, Inc. (AGA), credited the State with proved gas reserves of 56.8 billion cubic feet, 7.0 billion less than at the end of 1967. New fields, revisions, and extensions added only 2.6 billion cubic feet to the reserves and were insufficient to compensate for the quantities extracted during the year.[5]

The Federal Power Commission authorized Kansas-Nebraska Natural Gas Co., Inc., to increase the working volume of the Huntsman gas-storage field from 6 billion to 8 billion cubic feet and to replace 26 miles of 12-inch pipeline with 16-inch pipe. Total cost was estimated at $960,000. The company also built 410 miles of small-diameter gas pipeline to serve irrigation pumps in the Imperial-Venango area.

Natural Gas Liquids.—Production of total natural gas liquids declined 11.2 percent; output of LP gases was down 8.7 percent and that of natural gasoline was down 17.7 percent. Much of this decline was attributable to the closure, in November, of the Kansas-Nebraska Natural Gas Co., Inc., gasoline plant at Huntsman field, Cheyenne County. This closure reduced the number of gasoline plants in the State to two—the Cities Service Oil Co. plant at Kimball and the Marathon Oil Co. plant in the West Sidney field—with a combined daily capacity of 24.5 million cubic feet of gas.

API and AGA estimated reserves of natural gas liquids at yearend 1968 at 2.1 million barrels, 181,000 barrels less than the estimate for the previous year.[6]

Petroleum.—Output of petroleum declined slightly (1.4 percent) from the 13.4 million barrels produced in 1967. Most fields continued to decline in output as their reservoirs were depleted. The State's leading field, Sleepy Hollow, however, had an increased yield of 64.8 percent to 3,284,871 barrels.[7] The increase resulted

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[5] American Gas Association, Inc., American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada as of Dec. 31, 1968. V. 23, May 1969, p. 120.

[6] Page 123 of work cited in footnote 5.

[7] Nebraska Oil and Gas Conservation Commission, Sidney, Nebr. Nebraska Oil Activity Summary, 1968, 5 pp.

Table 5.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1967	1968	Principal fields in 1968
Banner	2,490	2,007	Singleton, Johnson, Harrisburg, Willson Ranch.
Cheyenne	2,597	2,158	Doran, Graff, Southwest Potter, Reimers.
Dundy	7	3	East Indian Creek, Rock Canyon.
Frontier	83	79	Bed Canyon.[1]
Furnas	2	2	Wilsonville.
Garden	11	10	Richards, McCord.
Harlan	27	27	South Alma, Prairie Dog Creek.
Hayes	1	1	Blackwood Creek.[2]
Hitchcock	283	249	Reiher.
Kimball	3,525	3,271	Bertramson, Enders, Sloss, Fernquist, Kimball, Axial.
Lincoln	4	1	Red Willow Creek, Blackwood Creek.[3]
Morrill	572	504	Waitman, Dunlap.
Red Willow	3,183	4,354	Sleepy Hollow, Silver Creek, Northwest Sleepy Hollow, Ackman, Midway, Bed Canyon.[4]
Richardson	58	76	Dawson, Falls City, Barada.
Scotts Bluff	530	441	Cedar Valley, Minatare.
Total	13,378	13,183	

[1] Partly in Red Willow County.
[2] Partly in Lincoln County.
[3] Partly in Hayes County.
[4] Partly in Frontier County.

Source: Nebraska Oil and Gas Conservation Commission.

from waterflood operations begun in 1966. Comprising 9,680 acres, the Reagan unit (producing from the Reagan Sandstone, believed to be Cambrian) and the Lansing unit with 6,637 acres (from the Lansing-Kansas City Formation, Pennsylvanian) are being successfully waterflooded on peripheral patterns. Operators estimate that an additional 15 million barrels of oil will be recovered from the Reagan unit because of waterflooding; the Lansing unit was estimated to have an additional 4 million barrels also recoverable by waterflooding.[5]

An extensive, successful development drilling program in the old Bertramson field discovered in 1956 in Kimball County brought that field to third rank among the State producers. The first two offset wells were dry; however, one well produced moderate amounts of oil during the next decade. In late 1967 a successful west offset was drilled, and in 1968 nine additional producing wells were completed. Output in 1968 was 312,661 barrels of oil, compared with about 44,000 in 1967.

An indication of the steady decline in oil output in the State is shown in the production data for the 25 largest fields. In 1967 the 25th field (Long) yielded 122,696 barrels of oil; in 1968, seven of the top 25 fields produced less than that quantity; and the 25th field (Minatare) had an output of 97,777 barrels.

Table 6.—Oil well drilling in 1968, by counties

County	Oil	Dry	Total	Footage
EXPLORATORY COMPLETIONS				
Banner	8	22	30	177,042
Box Butte	---	1	1	3,919
Cheyenne	4	38	42	213,659
Dakota	---	1	1	56
Deuel	---	1	1	3,739
Dundy	---	1	1	5,238
Frontier	1	5	6	22,441
Gage	---	1	1	321
Garden	---	1	1	3,695
Gosper	---	2	2	7,239
Hitchcock	---	2	2	8,777
Holt	---	1	1	2,592
Kimball	8	35	43	272,552
Lincoln	---	2	2	8,169
Morrill	---	10	10	45,304
Nance	---	2	2	6,208
Red Willow	3	17	20	74,119
Richardson	---	6	6	17,299
Scotts Bluff	---	12	12	68,961
Sheridan	---	3	3	10,533
Sioux	---	8	8	40,693
Total	24	171	195	992,556
DEVELOPMENT COMPLETIONS				
Banner	5	18	23	140,547
Cheyenne	6	10	16	82,887
Frontier	1	---	1	4,010
Hayes	---	1	1	4,912
Kimball	20	18	38	229,926
Red Willow	6	3	9	30,470
Richardson	2	---	2	4,895
Total	40	50	90	497,647
Total all drilling	64	221	285	1,490,203

Source: Committee on Statistics of Drilling, American Association of Petroleum Geologists.

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[5] Bleakley, W. B. Sleepy Hollow Floods Respond. Oil and Gas J., v. 66, No. 32, Aug. 5, 1968, pp. 116–120.

Because of the great increase in production from Sleepy Hollow field, Red Willow County, with 36.8 percent more output than in 1967, displaced Kimball County as the leading producer. With the exception of Richardson (in the Forest City basin of southeastern Nebraska), Harlan, and Hayes Counties, all counties had decreases in output. Two successful development wells in Richardson County were completed, which added to its oil production.

As of December 31, 1968, 1,403 oil wells were producing; 583 were shut in or temporarily abandoned. This was a decline of 27 from the 1,430 producing oil wells in 1967 and a decline of 26 in number of shut-in wells. Kimball County, with 382 wells, again led in number of producing wells, compared with 377 in 1967; Red Willow was second with 337, a slight decrease from the 350 of the previous year; Cheyenne County had 253; and Banner County had 241. These four counties accounted for 86 percent of the producing wells.[9]

Entirely the result of heightened exploration, drilling activity was 21.8 percent above the total 234 wells drilled in 1967; 195 wildcat wells were completed during the year, compared with 107 during 1967. Development completions dropped from 127 in 1967 to 90 in 1968. Kimball County accounted for 42 percent of the field wells and 50 percent of the successes. Banner County had an unusually large proportion of dry development wells.

Kimball and Cheyenne Counties had the largest number of exploratory wells—43 and 42, respectively. Wildcat success ratio for the year was 12.3 percent, somewhat better than the 9.3-percent success ratio for 1967. Banner and Kimball Counties had the greatest number of successful wildcats, eight wells each. Based on initial potential, the most significant discovery was the King Resources Co., Greathouse No. 1, NW¼ NE¼ sec 11, T19N, R55W, Banner County. This discovery, subsequently named the Link field, yielded 264 barrels of oil per day from the "D" Sandstone (Cretaceous). The Axial field discovery in Kimball County also was important. The discovery well, Patrick A. Doheny, Scheele No. 1, SE¼ NW¼ sec 13, T15N, R54W, was completed for a pump gage of 177 barrels of oil per day from the "J" Sandstone (Cretaceous). By yearend, two additional wells had been completed in the field. Production for the year totaled 98,722 barrels.

Richardson County, in the Forest City basin, had a flurry of drilling. Six wildcats and two development wells were drilled. Both field wells were successful; the exploratory wells were dry. Most of the exploratory wells were drilled to the Viola Limestone (Ordovician); average total depth was 2,883 feet.

API and AGA estimated as of January 1, 1969, State crude oil reserves totaled 55.3 million barrels, 7.8 million less than those for the previous year. Additions to reserves from new discoveries, revisions, and extensions amounted to 5.9 million barrels but did not offset reserve reductions because of production.[10]

The CRA, Inc., refinery at Scottsbluff, the one oil refinery in the State, had a daily crude oil capacity of 4,000 barrels. Phillips Petroleum Co. announced plans for building a 400-ton-per-day liquid fertilizer plant adjacent to its present facilities at Beatrice; the addition was scheduled for completion in early 1969.[11]

Nuclear Fuel.—Nuclear fuel was approved as the source of energy for a powerplant to be built by Consumers Public Power District of Columbus. The plant will be located on the west bank of the Missouri River between Brownville and Nemaha. The 778,000-kilowatt plant, to be known as the Cooper Nuclear Station, is to be in operation by April 1972.

NONMETALS

Cement.—Ash Grove Cement Co., formerly Ash Grove Lime & Portland Cement Co., in Cass County, increased production nearly 2 percent over that of 1967. Ideal Cement Co. Division, Ideal Basic Industries, Inc., completed renovating its plant at Superior in Nuckolls County. This renovation was a significant factor in the State's 11-percent increase in shipments. The average price per barrel of portland and masonry cements remained approximately the same.

Clays.—Production of clay by Ash Grove Cement Co., Endicott Clay Products Co., Omaha Brick Works, Western Brick and Aggregate Co., and Yankee Hill Brick

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[9] Page 2 of work cited in footnote 7.

[10] Pages 26–27 of work cited in footnote 5.

[11] Oil and Gas Journal. V. 66, No. 13, Mar. 25, 1968, p. 88.

Manufacturing Co. totaled 148,171 tons—17 percent over that of 1967.

Lime.—The Great Western Sugar Co., a subsidiary of Great Western United Corp., produced lime using limestone from its Wyoming quarry. Great Western United Corp. was formed on January 15, 1968, from the various individual operations of The Great Western Sugar Co. and other operations. Before January 15 the various components had not been brought together under coordinated management. Because of the increased use of lime in beet processing and pollution control, lime consumption was up substantially.

Perlite.—Zonolite Division, Western Region, W. R. Grace & Co., processed crude perlite from out-of-State sources for use as lightweight aggregate in concrete and plasters, loose-fill insulation, paint additive, soil conditioner, and textured granules. Production was down about 6 percent.

Pumice.—Ore treated by LaRue Axtell Pumice Co. at the Callaway plant came from the LeMaster mine southwest of Arnold in Lincoln County. Pumice is used mainly in cleaning and scouring compounds and hand soap.

Sand and Gravel.—Sand and gravel production increased nearly 11 percent in quantity and 21 percent in total value. Output was reported in all but 13 counties from 314 operations—246 commercial operations and 68 Government-and-contractor operations. The overall average value for sand and gravel was $1.01 per ton, an average increase of 8 cents per ton over the 1967 figure.

Table 7.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	2,011	$1,643	2,592	$2,400
Paving	1,127	1,059	961	881
Fill	847	682	690	620
Other	17	21	15	17
Industrial sand: Unspecified	1	1	1	1
Total	4,003	3,406	4,259	3,919
Gravel:				
Construction:				
Building	1,174	1,158	1,227	1,263
Paving	5,230	5,073	6,098	6,641
Railroad ballast	2	3	21	17
Fill	34	29	177	210
Other	1	1	10	11
Miscellaneous	177	186	263	271
Total	6,618	6,450	7,796	8,413
Total sand and gravel	10,621	9,856	12,055	12,332
Government-and-contractor operations:				
Sand:				
Paving	240	225	181	181
Fill	--------	--------	8	4
Total	240	225	189	185
Gravel:				
Building	15	8	--------	--------
Paving	863	789	769	658
Total	878	797	769	658
Total sand and gravel [1]	1,118	1,021	958	842
All operations:				
Sand	4,243	3,631	4,448	4,104
Gravel	7,496	7,247	8,565	9,071
Total	11,739	10,878	13,013	13,175

[1] Data may not add to totals shown because of independent rounding.

Table 8.—Sand and gravel production in 1968, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Adams	72	$87	Kearney	96	$91
Antelope	100	81	Keith	649	747
Banner	72	43	Keya Paha	13	9
Blaine	(1)	(1)	Kimball	18	18
Boone	W	W	Knox	82	80
Boyd	25	31	Lancaster	57	41
Brown	W	W	Lincoln	180	114
Buffalo	295	289	Loup	21	21
Butler	229	289	McPherson	(1)	(1)
Cass	574	449	Madison	283	418
Cedar	W	W	Merrick	W	W
Chase	22	22	Morrill	183	170
Cherry	W	W	Nance	W	W
Cheyenne	148	90	Nemaha	3	3
Clay	W	W	Nuckolls	W	W
Colfax	109	92	Pawnee	W	W
Cuming	484	541	Perkins	58	29
Custer	100	92	Phelps	108	W
Dakota	18	23	Pierce	W	W
Dawson	358	250	Platte	616	901
Deuel	61	42	Polk	W	W
Dixon	41	92	Red Willow	94	96
Dodge	819	622	Richardson	5	5
Douglas	1,660	1,719	Rock	12	12
Dundy	1	1	Saline	W	140
Fillmore	65	102	Sarpy	417	340
Franklin	80	54	Saunders	825	728
Frontier	W	W	Scotts Bluff	176	210
Furnas	57	45	Seward	36	36
Gage	193	256	Sheridan	13	13
Garden	13	9	Stanton	W	W
Garfield	5	6	Thayer	103	113
Hall	862	997	Thomas	26	21
Hamilton	W	W	Valley	64	81
Harlan	W	W	Wayne	1	1
Hayes	W	W	Webster	77	45
Hitchcock	86	71	Wheeler	13	17
Holt	141	94	York	603	671
Hooker	12	8	Undistributed	1,174	1,230
Howard	85	70			
Jefferson	214	211	Total [2]	13,018	13,175
Johnson	4	6			

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Less than ½ unit.

[2] Data may not add to totals shown because of independent rounding.

Stone.—Dimension and crushed limestone produced in 19 of the 93 counties decreased slightly in value and nearly 9 percent in quantity. The average unit value of the stone was $1.68 per ton, an increase of 9 percent from $1.54 per ton in 1967.

Talc.—The United Sierra Division, Cyprus Mines Corp., processed 11 percent more talc than in 1967. Crude material came from Montana and California. Processed material was used in ceramics, paint, paper, rubber, textiles, tile, and toilet preparations. Some of the processed material also was exported.

Vermiculite.—Zonolite Division, Western Region, W. R. Grace & Co., exfoliated vermiculite for use as loose-fill insulation, plaster aggregate, concrete aggregate, fire base, and for agricultural use. Output increased nearly 9 percent.

METALS

Antimony, bismuth, gold, lead, and silver were recovered at the Omaha refinery of American Smelting and Refining Co. from lead bullion and other smelter products shipped from out-of-State sources.

Table 9.—Stone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967		1968	
	Quantity	Value	Quantity	Value
Dimension stone: Rubble	11	$60	5	$27
Crushed and broken stone:				
Riprap	2,004	2,171	1,237	1,773
Concrete and roadstone	1,621	2,677	(1)	(1)
Concrete aggregate	NA	NA	300	W
Dense graded roadbase	NA	NA	510	772
Agriculture	228	391	262	431
Lime	5	9	---------	---------
Other	[2] 977	[2] 2,175	[3] 2,103	[3] 4,432
Total [4]	4,835	7,423	4,411	7,408
Grand total	4,846	7,483	4,416	7,435

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Other."

(1) Concrete and roadstone subdivided into concrete aggregate and various aggregates used for road construction; bituminous aggregate, macadam aggregate, and surface treatment aggregate withheld to avoid disclosing individual company confidential data; included with "Other."

[2] Includes stone used in asphalt filler, cement, mineral food, other filler, poultry grit, railroad ballast, and rubber filler.

[3] Includes stone used in asphalt filler, bituminous aggregate, cement, macadam aggregates, poultry grit and mineral food, railroad ballast, surface treatment aggregates, and whiting and item indicated by the symbol W.

[4] Data may not add to totals shown because of independent rounding.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ash Grove Cement Co.	1000 Tenmain Center Kansas City, Mo. 64105	Wet-process, 6-rotary-kiln plant.	Cass.
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	620 Ideal Cement Bldg. Denver, Colo. 80202	Wet-process, 2-rotary-kiln plant.	Nuckolls.
Clays:			
Ash Grove Cement Co.	1000 Tenmain Center Kansas City, Mo. 64105	Removal of overburden at quarry and plant.	Cass.
Western Brick & Aggregate Co.	Box 1141 Nebraska City, Nebr. 68410	Open-pit mine	Otoe.
Yankee Hill Brick Manufacturing Co.	730 Stuart Bldg. Lincoln, Nebr. 68508	do	Lancaster.
Lime:			
The Great Western Sugar Co., a subsidiary of Great Western United Corp.	Box 5308 Denver, Colo. 80217	1-shaft kiln at beet-sugar plant.	Morrill.
		One 1-shaft kiln and two 2-shaft kilns at beet-sugar plants.	Scotts Bluff.
Natural gas and petroleum [1]			
Pumice: LaRue Axtell Pumice Co.	Callaway, Nebr. 68825	Open-pit mine	Lincoln.
Sand and gravel:			
Central Sand & Gravel Co.	Box 626 Columbus, Nebr. 68601	Dredging operation	Butler.
		2 dredging operations	Madison.
		3 dredging operations	Platte.
Christensen Sand & Gravel Co.	Fremont, Nebr. 68025	3 pits and plants	Dodge.
		Pit and plant	Douglas.
Hartford Sand & Gravel Co.	Box 571 Valley, Nebr. 68064	2 dredging operations	Do.
Luther & Maddox Gravel Co.	Grand Island, Nebr. 68801	4 dredging operations	Hall.
Lyman-Richey Sand & Gravel Corp.	4315 Cuming Street Omaha, Nebr. 68131	Dredging operation	Cass.
		2 dredging operations	Dodge.
		do	Douglas.
		Dredging operation	Morrill.
		do	Platte.
		2 dredging operations	Sarpy.
		Dredging operation	Saunders.
McCann Sand & Gravel Co.	Valley, Nebr. 68064	2 dredging operations	Douglas.
Olson Sand & Gravel Co.	Route 2 Franklin, Nebr. 68939	2 pits and plants	Keith.
Overland Sand & Gravel Co.	22 Main Street Stromberg, Nebr.68666	Dredging operation	Hamilton.
		3 dredging operations	Merrick.
		Dredging operations	Nance and Polk.
Sorensen Sand & Gravel	2851 Potter Street Omaha, Nebr. 68112	Dredging operations	Douglas and Sarpy.
Troudt-Meridian Construction Co.	York, Nebr. 68467	3 dredging operations	York.
Western Sand & Gravel Co.	Box 268 Lincoln, Nebr. 68501	Dredging operation	Cass.
		2 dredging operations	Saunders.
Stone:			
Ash Grove Cement Co.	1000 Tenmain Center Kansas City, Mo. 64105	Quarry and plant	Cass.
Fort Calhoun Stone Co.	1255 South Street Blair, Nebr. 68008	do	Washington.
Hopper Bros. Quarries	Weeping Water, Nebr. 68463	3 quarries and plant	Cass.
		Quarry and plant	Gage.
		do	Nemaha.
		do	Nuckolls.
		do	Otoe.
		do	Pawnee.
		do	Richardson.
		do	Saline.
		do	Thayer.

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[1] Most of the major oil and gas companies and many smaller companies operate in Nebraska and several commercial directories contain complete lists of them.

The Mineral Industry of Nevada

This chapter has been prepared under a cooperative agreement for the collection of mineral data between the Bureau of Mines, United States Department of the Interior, and the Nevada Bureau of Mines for collecting information on all minerals except fuels.

By Arthur C. Meisinger [1]

Increased value of mineral production and intensive exploration activity highlighted Nevada's mineral industry in 1968. The State's mineral production reached $120 million, a 32-percent increase over that of 1967, and was exceeded only by the 1956 figure of $126.7 million. The 8½-month labor strikes that affected most copper, lead, and zinc producers and were largely responsible for the decline in the value of Nevada's 1967 mineral production were settled by April 1, 1968.

Copper accounted for over 50 percent of the total value of production and more than offset value losses of most other metals. Of the 27 metal and mineral commodities

Table 1.—Mineral production in Nevada [1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Antimony ore and concentrates (content) _____ short tons	53	$35	---------	---------
Barite (crude) _____ thousand short tons	154	923	216	$1,511
Copper (recoverable content of ores, etc.) _____ short tons	50,771	38,815	77,213	64,623
Gem stones	NA	100	NA	100
Gold (recoverable content of ores, etc.) _____ troy ounces	434,993	15,225	317,382	[2] 12,460
Gypsum _____ thousand short tons	409	1,412	552	1,534
Iron ore (usable) _____ thousand long tons, gross weight	641	2,858	569	2,917
Lead (recoverable content of ores, etc.) _____ short tons	1,500	420	863	228
Mercury _____ 76-pound flasks	4,703	2,301	4,780	2,560
Perlite _____ short tons	10,712	94	9,315	79
Petroleum (crude) _____ thousand 42-gallon barrels	279	W	271	W
Pumice, pumicite, and volcanic cinder thousand short tons	105	236	62	144
Sand and gravel _____ do	10,166	8,644	7,812	10,442
Silver (recoverable content of ores, etc.) thousand troy ounces	566	877	645	1,384
Stone _____ thousand short tons	1,375	2,145	1,325	2,041
Talc and soapstone _____ short tons	2,096	17	3,029	38
Tungsten concentrate _____ short tons, 60% WO_3 basis	W	W	25	58
Zinc (recoverable content of ores, etc.) _____ short tons	3,035	840	2,104	568
Value of items that cannot be disclosed: Brucite, cement, clays, diatomite, fluorspar, lime, lithium minerals, magnesite, molybdenum concentrates (content), peat (1967), salt, and values indicated by symbol W	XX	15,941	XX	19,354
Total	XX	90,883	XX	120,041
Total 1957–59 constant dollars	XX	r 77,400	XX	p 94,816

p Preliminary. r Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Based on average U.S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968, and the New York selling price for the remainder of the year.

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[1] Mineral specialist, Bureau of Mines, San Francisco, Calif.

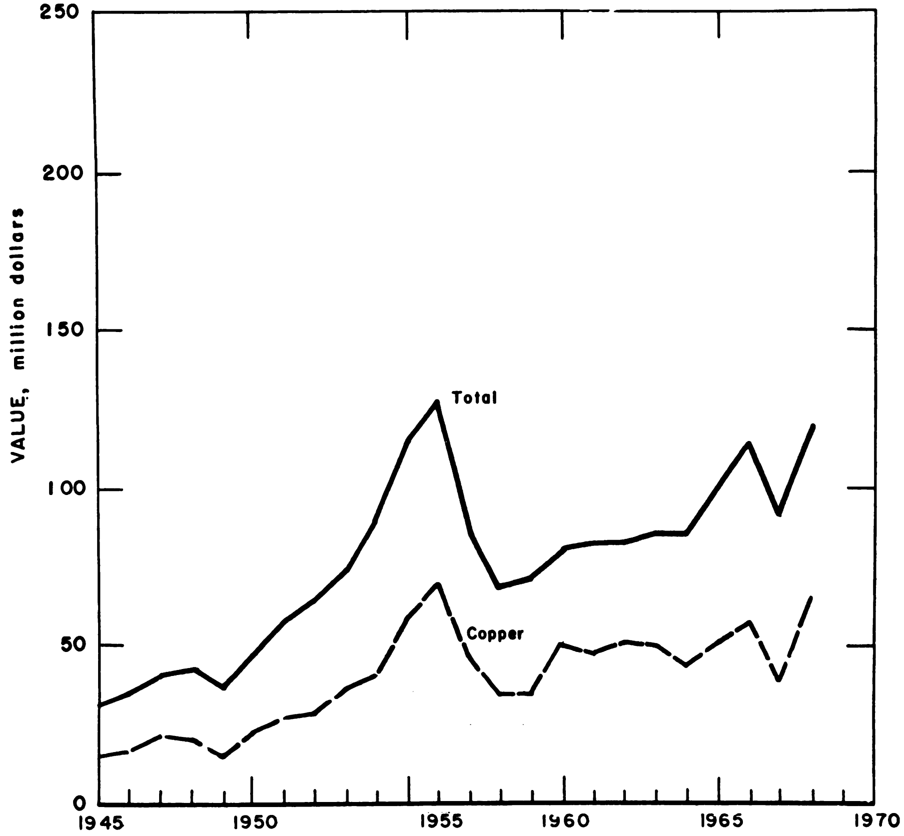

Figure 1.—Value of copper and total value of mineral production in Nevada.

produced, nine were metals, and 17 were nonmetals, with petroleum as the sole fuel commodity. Output of only four metals (copper, mercury, silver, and tungsten) and 10 nonmetals (barite, brucite, cement, clay, gypsum, lime, lithium compounds, magnesite, salt, and talc and soapstone) increased compared with that of 1967.

Although sand and gravel tonnage was substantially less than in 1967, value of production increased because higher-grade material with a greater unit value supplied the commercial market demand; this demand was about the same as in 1967. No antimony ore or peat was mined during 1968.

Exploration activity, principally for gold, silver, mercury, and copper, continued at the high pace set in 1967. More than 70 exploration programs in 15 Nevada counties were reported to the Bureau of Mines. Seventeen wells, 12 of which were exploratory wells in the vicinity of the Eagle Springs field, Nye County, were drilled for crude oil. One well was drilled in the Nye County oilfield, but failed to develop commercial production.

Consumption, Trade, and Markets.—Out-of-State processors supplied all of Nevada's requirements for mineral fuels and metals, and virtually all of the nonmetallic mineral needs other than construction materials.

All of the talc and fluorspar, most of the barite and perlite, and some of the gypsum and limestone were shipped out of State in crude form. Much of the lime output went to customers in California, Washington, and Oregon. All petroleum production was consigned to refineries in Utah. With

Table 2.—Value of mineral production in Nevada, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Churchill	$457	$406	Sand and gravel, tungsten, salt, silver, lead, gold, zinc.
Clark	9,668	12,319	Sand and gravel, lime, stone, gypsum, silver, gold, lead, clays zinc.
Douglas	2,112	W	Iron ore, silver, sand and gravel, gold, copper.
Elko	1,695	2,270	Copper, barite, sand and gravel, silver, lead, zinc, mercury, gold.
Esmeralda	1,845	2,768	Lithium, diatomite, mercury, talc and soapstone, salt, clays, sand and gravel, silver, copper, lead.
Eureka	12,558	11,737	Gold, iron ore, zinc, mercury, stone, lead, barite, sand and gravel, silver, copper.
Humboldt	4,126	1,614	Mercury, sand and gravel, gold, silver, copper, lead, zinc.
Lander	5,837	10,130	Copper, barite, silver, gold, sand and gravel.
Lincoln	1,774	996	Zinc, silver, lead, perlite, fluorspar, sand and gravel, copper, stone, gold, pumicite.
Lyon	22,181	37,176	Copper, cement, stone, sand and gravel, diatomite, clays, silver, gold.
Mineral	50	216	Lead, zinc, silver, mercury, copper, stone, sand and gravel, barite, gold.
Nye	2,559	2,771	Magnesite, petroleum, fluorspar, sand and gravel, brucite, mercury, gold, volcanic cinder, silver, clays, lead, zinc, stone, copper.
Ormsby	W	860	Sand and gravel, volcanic cinder, stone, tungsten, gold, silver.
Pershing	4,421	4,885	Diatomite, mercury, gypsum, iron ore, copper, sand and gravel, perlite, tungsten, silver, stone, lead, gold, zinc.
Storey	W	W	Diatomite, pumice.
Washoe	2,181	3,012	Sand and gravel, stone, mercury, pumicite and volcanic cinder, clays, silver.
White Pine	16,846	24,448	Copper, gold, molybdenum, silver, lime, stone, sand and gravel, tungsten, clays, lead.
Undistributed [1]	2,573	4,433	
Total	90,883	120,041	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes gem stones and tungsten that cannot be assigned to specific counties and value indicated by symbol W.

few exceptions, metal ores, concentrates, and precipitates were processed in mills and smelters outside the State. The one smelter (copper) in Nevada, at McGill, was dependent on Nevada ores. All usable iron ore was exported or shipped to steel plants in other States. The electrolytic manganese dioxide plant of American Potash & Chemical Corp., Clark County, operated on ore purchased from out-of-State producers, and the tungsten carbide plant, Kennemetal, Inc., Mineral County, used concentrates purchased from producers in Arizona, California, Nevada, Montana, and Utah.

Trends and Development.—Exploration in Nevada continued at the high pace set in 1967. Reports to the Bureau of Mines indicated that more than 70 programs were actively pursued in 15 counties for 10 different mineral commodities—eight metals and two nonmetallic minerals. Gold led all commodities with 22 exploration projects, followed by silver with 19, mercury 12, copper seven, lead five, and tungsten four. Over 70 percent of the exploration projects were conducted in six counties—Elko, Lander, Mineral, Pershing, Washoe, and White Pine.

Kennecott Copper Corp., White Pine County, announced plans for a 5-year development program of its eastern Nevada operations. The Anaconda Company reported it expected to continue producing copper from the Yerington mine, Lyon County, for another 15 years, based on improved techniques for treating low-grade ores. Duval Corp., Lander County, operated its copper concentrator at Copper Canyon and made plans to ship some copper concentrate to Chile for processing on a toll basis. Triangle Explorations, Inc. (wholly owned subsidiary of Triangle Conduit and Cable Co.), began developing a new mercury deposit south of Winnemucca, northern Pershing County, and Star City Mines, Ltd. (51-percent-owned by Triangle Explorations, Inc.) completed construction of and began operating a processing mill on the property.

International Precious Metals, Inc., a new company, began construction of a

Table 3.—Indicators of Nevada business activity

	1967 [r]	1968 [p]	Change (percent)
Employment and labor force, annual average:			
Total civilian work force .... thousands..	203.1	211.7	+4.2
Employed .... do....	190.3	200.8	+5.5
Unemployed .... do....	12.2	10.5	−13.9
Employment:			
Agriculture .... do....	4.6	4.6	--------
Mining [1] .... do....	3.5	3.5	--------
Contract construction .... do....	8.0	9.7	+21.2
Manufacturing .... do....	6.7	6.9	+3.0
Government .... do....	32.3	34.0	+5.3
Other [2] .... do....	115.7	122.5	+5.9
Payroll data:			
Total [3] .... millions..	$70,122	$78,990	+12.6
Mining .... do....	$2,319	$2,390	+3.1
Contract construction .... do....	$6,409	$7,875	+22.9
Manufacturing .... do....	$4,190	$4,603	+9.8
All other [3] .... do....	$57,204	$64,122	+12.1
Personal income:			
Total .... do....	$1,591	$1,792	+12.6
Per capita	$3,583	$3,992	+11.4
Construction activity:			
Valuation of private authorized nonresidential construction [4] millions..	$35.1	$46.6	+32.8
Valuation of private and public-owned residential construction (permit authorized and contract awarded) .... millions..	$32.1	$64.6	+101.2
State government capital outlay for highway construction...do....	$29.4	$29.7	+1.0
Consumption of cement in Nevada, including out-of-State receipts thousand 376-pound barrels..	1,164	1,350	+16.0
Business receipts:			
Total retail trade (all establishments) .... millions..	$893.8	NA	NA
Farm marketing receipts:			
Farm income—cash receipts .... do....	$63.9	NA	NA
Mineral production .... do....	$90.9	$120.0	+32.0
Electrical energy:			
Production .... million kilowatt hours..	359,014	NA	NA
Sales .... do....	386,698	NA	NA

[r] Revised. [p] Preliminary. NA Not available.

[1] May vary from Bureau of Mines canvass.

[2] Includes transportation (other than railroads), utilities, trade (wholesale and retail), finance, insurance, real estate, and services.

[3] Excludes Federal Government.

[4] Includes nonresidential additions and alterations.

Sources: Bureau of Mines, Construction Review, Survey of Current Business, Statistical Abstract of the United States, State Government Finances, 1967 Census of Nevada Business, Nevada Employment Security Department in cooperation with the United States Department of Labor, Nevada Business Review.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Metal	1,979	236	467	3,735	2	99	27.04	4,035
Nonmetal and peat...	719	255	183	1,468	1	44	30.66	4,601
Sand and gravel......	686	219	150	1,187	-------	20	16.84	442
Stone	323	245	79	634	-------	10	15.78	393
Total [1]	3,707	237	880	7,024	3	173	25.06	3,218
1968:[p]								
Metal	1,835	256	471	3,777	3	91	24.89	5,768
Nonmetal and peat...	740	249	185	1,479	-------	36	24.34	519
Sand and gravel......	605	211	128	1,014	-------	20	19.73	471
Stone	320	261	84	672	1	14	22.33	9,385
Total [1]	3,505	247	868	6,942	4	161	23.77	4,226

[p] Preliminary.

[1] Data may not add to totals shown because of independent rounding.

precious metals refinery, the first in Nevada, on the William P. Lear industrial site, Reno, to refine secondary gold, platinum-group metals, and silver. Also on the Lear industrial site, Titanium West, Inc., completed a plant for producing titanium sponge. The plant has a designed titanium sponge melting capacity of approximately 3,600 tons per year.

American Potash & Chemical Corp. initiated construction (planned in 1967) for expanding its Henderson, Clark County, electrolytic manganese dioxide plant from 6,000 to 10,000 tons per year. Candelaria International Mining and Milling Co. purchased the Esmeralda County mining claims of Argentum Mining Co. Ordrich Gold Reserves Co. Inc. executed its option in April to purchase the Round Mountain properties of Nevada Porphyry Gold Mines, Inc., Nye County. Silver Mining, Smelting, and Refining Co. purchased the Tybo, Dimmick, and V. J. Brandt mines and 30 additional claims in Nye County.

Legislation and Government Programs.—Public land orders by the U.S. Bureau of Land Management withdrew 31,400 acres of land from mineral location under U.S. mining laws of which 25,300 acres remained open to mineral leasing. Other land orders restored 140 acres to mineral location in Clark and Nye Counties and 2,400 acres to mineral leasing in Washoe County. Nearly 29,200 acres was opened to mineral entry, location, patenting, and leasing in 10 counties, although mineral fuels were excluded on 2,600 acres of this land in Washoe County and 120 acres in Humboldt County. Nevada received U.S. Treasury checks totaling $643,468.64 in bonuses, royalties, and rentals covering mineral leases and permits.

Of the 11 applications received from Nevada producers since enactment of the Lead-Zinc Stabilization Program in October 1962, two had been recertified (after June 1, 1966), two were denied, and seven had been withdrawn, suspended, or disqualified. Payments totaling $4,246 were made on 37.5 tons of lead and 302.3 tons of zinc produced in 1968.

The Bureau of Mines continued to provide consulting service to the Atomic Energy Commission (AEC) in connection with underground nuclear tests at the Nevada Test Site, Nye County.

Continuing research by the Bureau of Mines Reno Metallurgy Research Center resulted in the following accomplishments: Development of a new procedure for preparing high-purity vanadium metal; separation of yttrium from euxenite-type lanthanide mixtures, yielding a 99.9-percent-pure yttrium oxide; the effective recovery of gold and silver by fused-salt electrolysis of scrap tin-lead solder; development of molten-salt techniques for recovering tungsten and molybdenum as metals or as carbides from their minerals or oxides; and the successful recovery of gold from carbonaceous ores by chemical and electrolytic oxidation treatment prior to cyanidation. Gold recovery of over 90 percent was obtained on ores containing 0.3 oz. gold per ton, as compared with only 6- to 32-percent extraction obtained by direct cyanidation without oxidation pretreatment.[2]

The Bureau of Mines Boulder City Metallurgy Research Laboratory continued research investigations in the winning and refining of specialty metals in molten-salt electrolytes. Under a contract with the AEC, high-purity vanadium was prepared and shipped to various contractors of the AEC vanadium program. The successful recovery of high-purity vanadium was a result of methods developed in electrorefining vanadium feed and scrap materials supplied by AEC contractors. Research on other specialty metals resulted in the electrowinning of titanium from titanium tetrachloride, and of 99-percent beryllium from beryllium oxide. Research was initiated on the recovery of elemental vanadium from vanadium alloys by molten-salt electrolysis, the electrowinning of zirconium from zirconium tetrachloride, and the electrolytic recovery of aluminum from aluminum scrap alloys. A preliminary study was concluded on beneficiation of the wastes generated by commercial titanium chlorination operations.

At yearend, the Bureau of Mines San Francisco Office of Mineral Resources began a study to provide forecasts regarding the mineral industry in the Great Basin hydrologic region for an interagency Type I Comprehensive Framework Study. This region includes nearly all of Nevada and parts of Utah, Idaho, and Wyoming.

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[2] Scheiner, B. J., R. E. Lindstrom, and T. A. Henrie. Electrolytic Oxidation of Carbonaceous Ores for Improving Gold Recovery. BuMines Tech. Prog. Rept. 8, January 1969, 12 pp.

The San Francisco Office was also active in furthering the development of gold resources in Nevada as part of a joint Bureau of Mines-Geological Survey Heavy Metals Program which began in mid-1966. The Nevada resource study was stimulated by encouraging results of Bureau of Mines metallurgical research on carbonaceous ores in an auriferous region of northeastern Nevada. The importance of conducting metallurgy research on heap-leaching of oxidized gold ores in the region was recognized[3] and subsequent appraisal of the oxidized ores identified several classes of material that might be treated more economically by heap-leaching than in conventional cyanide plants. Initial metallurgy research indicated that heap-leaching might be an attractive method for treating large tonnages of oxidized gold ores in the region that are not economically amenable to treatment by conventional milling methods.

The Region II Field Office, Office of Minerals Exploration (OME), U.S. Geological Survey, received nine new applications from persons interested in exploring for minerals in Nevada under the OME program. New contracts were approved with Basic Resources Corp., Long Beach, Calif., and Bristol Silver Mines Company, Pioche, Nev., for silver exploration in Pershing and Lincoln Counties, respectively; and with Claude B. Lovestedt for gold and silver exploration in Churchill County. Eight contracts were in force at yearend.

COMMODITY REVIEW

METALS

Antimony.—No activity was reported from any Nevada antimony mine in 1968.

Copper.—The 8½-month industry-wide strike, which began in mid-July 1967, was settled by April 1, 1968, and copper production in Nevada rose 52 percent over that of 1967. Most of the output came from the State's three major producers—The Anaconda Company, Lyon County; Kennecott Copper Corp., White Pine County; and Duval Corp., Lander County. The Rio Tinto mine, Elko County, and the Big Mike Corp. mine, Pershing County, also contributed significantly to the total copper output. Lesser quantities were recovered as a byproduct from complex lead, zinc, and silver ores. Phasing-in operations began in July with the removal of nearly 60 million tons of overburden at the new Ruth Pit of Kennecott Copper Corp., White Pine County. Cerro Corp., in a joint venture with Big Mike Corp., began an extensive exploration and drilling program on the Big Mike property, Pershing County. Duval Corp., Lander County, processed ore in its 4,000-ton-per-day copper concentrator at Copper Canyon.

Gold.—Gold output was 27 percent less than in 1967, despite a nearly 30-percent increase in byproduct gold. The closure of the Getchell mine at the end of 1967 and lower production at the Carlin mine, Eureka County, were the factors largely responsible for the decrease. Copper ores yielded nearly all of the byproduct gold. Seven lode gold mines and four placer operations reported production, but the quantity of placer gold produced was minor.

The Cortez Joint Venture, Lander County, following engineering feasibility studies, completed the necessary mine development at its Crescent Valley gold property near Cortez and stockpiled ore for processing in a 1,500 ton-per-day mill which was completed at yearend 1968.

Iron Ore.—Production and shipments of usable iron ore dropped 11 percent. Two-thirds of the total output was exported. Less than one-third of the shipments was direct shipping-grade ore. Direct shipping-grade ores were produced and shipped by Nevada Barth Corp., Eureka County, and Nevada Iron Ore Co., Inc., Pershing County. Standard Slag Co., Douglas County, produced iron ore concentrate for export at its Wabuska plant in Lyon County.

The Geo. B. Smith Chemical Works, Inc. iron oxide pigment plant at Jean, Clark County, was not in operation during 1968.

Lead.—Most lead producers in Nevada resumed operations in April, shortly after settlement of the 8½-month labor strike.

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[3] Merwin, Roland W. Gold Resources in the Oxidized Ores and Carbonaceous Materials in the Sedimentary Beds of Northeastern Nevada. BuMines Tech. Prog. Rept. 1, March 1968, 16 pp.

Table 5.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals[1]

Year	Mines producing [2]		Material sold or treated [3] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
1964	38	6	13,383	90,469	$3,166	172,447	$223
1965	48	5	15,817	229,050	8,017	507,113	656
1966	51	10	16,229	366,903	12,842	867,567	1,122
1967	28	5	10,480	434,993	15,225	565,755	877
1968	49	4	14,209	317,382	12,460	645,192	1,384
1904-68 [4]	-------	-------	NA	16,767,797	436,245	319,531,404	222,066

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1964	67,272	$43,861	809	$212	582	$158	$47,620
1965	71,332	50,503	2,277	710	3,858	1,127	61,013
1966	78,720	56,946	3,581	1,083	5,827	1,690	73,683
1967	50,771	38,815	1,500	420	3,035	840	56,177
1968	77,213	64,623	863	228	2,104	568	79,263
1904-68 [4]	3,238,458	1,411,440	402,577	65,326	499,331	98,002	2,233,079

NA Not available.

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore and old tailings shipped to smelters during calendar year indicated.

[2] Excludes itinerant prospectors, "snipers," "high graders," and others who gave no evidence of legal right to property.

[3] Does not include gravel washed.

[4] The first satisfactory annual canvass of mine production was made in 1904.

Table 6.—Mine production of gold, silver, copper, lead, and zinc in 1968, by counties, in terms of recoverable metals

County	Mines producing [1]		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Troy ounces	Value	Troy ounces	Value
Clark	5	1	6	$236	1,313	$2,816
Elko	6	---------	31	1,217	29,083	62,371
Eureka	3	---------	W	W	3,279	7,032
Humboldt	5	1	937	36,786	2,305	4,943
Lincoln	3	---------	58	2,277	138,701	297,458
Mineral	6	---------	24	942	20,040	42,978
Nye	5	1	274	10,757	1,597	3,425
Ormsby	-------	1	W	W	8	17
Pershing	6	---------	W	W	6,623	14,204
White Pine	3	---------	W	W	W	W
Undistributed [2]	7	---------	316,052	12,408,202	442,243	948,435
Total	49	4	317,382	12,460,417	645,192	1,383,679

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Clark	-------	----------	1	$211	(3)	$27	$3,290
Elko	W	W	164	43,401	31	8,262	1,592,032
Eureka	1	$962	36	9,579	227	61,304	11,071,402
Humboldt	(3)	418	1	291	(3)	14	42,452
Lincoln	W	W	459	121,326	W	W	882,770
Mineral	W	W	W	W	W	W	152,429
Nye	W	W	W	W	W	W	15,423
Ormsby	-------	----------	--------	--------	--------	--------	253
Pershing	W	W	19	4,941	1	297	134,072
White Pine	W	W	1	225	--------	--------	23,856,344
Undistributed [2]	77,212	64,621,268	182	48,065	1,845	498,176	41,512,396
Total	77,213	64,622,648	863	228,039	2,104	568,080	79,262,863

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed".

[1] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal rights to property.

[2] Includes Churchill, Douglas, Esmeralda, Lander, Lyon, and Washoe counties and counties indicated by symbol W.

[3] Less than ½ unit.

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1968, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Gold	8	777,346	280,275	153	-------	-------	-------
Silver	16	27,093	224	28,554	5	5	3
Copper	6	13,230,474	36,004	424,336	74,271	-------	-------
Lead	14	9,191	36	36,283	6	214	32
Lead-zinc	3	70,304	69	153,820	28	602	1,835
Zinc	2	1,151	4	1,424	1	42	234
Total	49	14,115,559	316,612	644,570	74,311	863	2,104
Other lode material:							
Copper precipitates	3	3,919	-------	-------	2,690	-------	-------
Gold (slag and matte)	(2)	20	733	588	(3)	-------	(3)
Old tailings	(2)	89,530	-------	-------	212	-------	-------
Total	3	93,469	733	588	2,902	-------	-------
Total lode material	49	14,209,028	317,345	645,158	77,213	863	2,104
Placer	4	(4)	37	34	-------	-------	-------
Total all sources	53	14,209,028	317,382	645,192	77,213	863	2,104

[1] Details will not necessarily add to totals shown, because some mines produce more than one class of material.
[2] From property not classed as a mine.
[3] Less than ½ unit.
[4] 1,590 cubic yards.

Table 8.—Mine production of gold, silver, copper, lead, and zinc in 1968, by types of material processed, and methods of recovery in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode:					
Amalgamation and cyanidation:					
Ore	280,291	170	--------	-------	-------
Old tailings	---------	---------	--------	-------	-------
Concentration and smelting of concentrates:					
Ore	35,603	597,513	[1] 72,542	641	1,836
Old tailings	---------	---------	212	-------	-------
Direct smelting:					
Ore	718	46,887	1,769	222	268
Copper precipitates	---------	---------	2,690	-------	-------
Slag and matte	733	588	(2)	-------	(2)
Total	317,345	645,158	77,213	863	2,104
Placer	37	34	--------	-------	-------
Grand total	317,382	645,192	77,213	863	2,104

[1] Includes copper from heap leaching, combined to avoid disclosing individual company confidential data.
[2] Less than ½ unit.

However, lead production was still only 57 percent of that in 1967. Although 29 lode mines contributed to the total lead output, only eight— one zinc mine, five lead mines, one lead-silver mine, and one lead-zinc mine—produced significant quantities. The Pan American lead-zinc mine, Lincoln County, which dominated the lead industry in Nevada in 1967, was idle throughout the year. However, ore shipments from stockpile at the mine site accounted for one-half of the total recoverable lead output in the State.

Mercury.—Although the unit price of mercury remained relatively high and averaged $535.56 per flask for the year, production increased only 2 percent over the 1967 figure. The total number of producers declined from 25 in 1967 to 17 in 1968, although six producers reported outputs of more than 100 flasks, compared with only three in 1967. Those producing over 100 flasks were Kollsman Mineral & Chemical Co. (B&B mine), Esmeralda County; Fred H. Lenway Co. (Cordero mine), Humboldt County; Crofoot Lumber Co. (Red Bird mine), Pershing County; Horton Bros. Mining Co. (Horton Mercury mine), Pershing County; Star City Mines, Ltd. (Goldbank mine), Pershing County; and Old West Enterprises (Old West mine), Washoe County. Three operators reported outputs of less than 10 flasks, compared with 15 in 1967. As in past years, the Cordero mine was the largest producer in the State with over half of the total production and shipments. One producer employed both a furnace and a retort to recover the metal, six producers used furnaces, and all others used retorts. Carlin Gold Mining Co., Eureka County, which began recovering mercury as a byproduct of gold production in 1967, continued to produce byproduct mercury throughout 1968. Tintic Lead Co. and Basin & Range Exploration Co. (joint venture) completed drilling on the Carmen mercury property near Gabbs, Nye County. Crofoot Lumber Co. (Red Bird mercury mine), Pershing County, completed installation of a second rotary furnace at its millsite, east of Lovelock.

Molybdenum.—Kennecott Copper Corp. recovered molybdenite as a byproduct in treating copper ore in the McGill concentrator, White Pine County. Production was slightly higher than in 1967, but shipments were substantially lower. The Anaconda Company announced that limited additional drilling had been conducted on the Hall molybdenum property near Tonopah, Nye County.

Silver.—Recoverable silver output increased 14 percent over that of 1967. Production was reported by 15 lode silver mines, eight more than in 1967. Copper ores yielded 66 percent of the total lode silver, lead-zinc ores, 24 percent, and all other ores, 10 percent. Less than 50 ounces of silver was recovered from placer gold operations.

Tungsten.—Ten tungsten properties, three more than in 1967, were active during most of the year. Small quantities of tungsten concentrates were shipped by operators in Churchill and Pershing Counties to a tungsten carbide plant in Mineral County. The plant also used concentrates purchased from producers in neighboring States. Some tungsten concentrates from Nevada were also shipped to a California paratungstate plant. Quicktung Mining Co. reported that exploratory drilling at yearend indicated the presence of a high-grade sheelite ore body on the company property, Pershing County. The company selectively mined high-grade tungsten ore during the year and trucked the ore to a processing mill in Fallon. Nevada-Massachusetts Co., Pershing County, conducted extensive geochemical exploration to locate extensions of known ore bodies in the mine area.

Zinc.—A total of 20 lode mines contributed to zinc output in Nevada. Zinc production was 31 percent less than in 1967. Nearly 80 percent of the total recoverable zinc came from stockpiled ore of the Pan American lead-zinc mine, Lincoln County.

Table 9.—Mercury production, by methods of recovery

Year	Direct-furnaced		Retorted		Total		Operating mines
	Ore (short tons)	Flasks	Ore (short tons)	Flasks	Flasks	Value[1] (thousands)	
1964	42,635	3,181	653	81	3,262	$1,027	21
1965	48,197	2,877	3,575	456	3,333	1,902	42
1966	48,813	3,021	14,633	334	3,355	1,482	29
1967	51,693	4,457	1,567	246	4,703	2,801	25
1968	67,711	4,325	5,842	455	4,780	2,560	17

[1] Value calculated at average New York price.

NONMETALS

Barite.—The quantity of primary barite sold or used by Nevada producers was 40 percent above that of 1967, but sales of ground barite, including tonnages used by producers, declined 12 percent. The major producers of crude barite ore were National Lead Co. (Rossi mine, Elko County), Dresser Minerals (Greystone group, Lander County), and FMC Corp. (Mountain Springs mine, Lander County). As in 1967, virtually all of the barite output was for use in well drilling.

Dresser Minerals and National Lead Co. ground barite in their respective plants near Battle Mountain, Lander County, and Dunphy, Eureka County.

Cement.—Nevada Cement Co., the State's sole producer of portland cement, continued to operate a dry-process plant at Fernley, Lyon County. The company's bulk and bag shipments of cement to customers in Nevada and northern California reached an alltime high. Total consumption of cement in Nevada, including white and other types received from out of State, amounted to 1,350,000 barrels.

At yearend, Nevada Cement Co. announced plans to double its production capacity and construct additional transfer and storage facilities to better serve its markets in central and southern Nevada. The $2 million expansion program, including the addition of a new kiln and ball mills at the Fernley plant, was scheduled for completion in late 1969.

Clays.—Western Talc Co. mined bentonite from three pits—the Francis near Apex, Clark County; the Blanco, near Mina, Esmeralda County; and the New Discovery near Beatty, Nye County—and prepared the material for use in cosmetics and pharmaceuticals. Industrial Minerals & Chemical Co. mined fuller's earth from the Jupiter deposit near Weeks, Lyon County, and sold the prepared material for use as a filler in animal feeds. Nevada Cement Co. obtained miscellaneous clay from its pit near Flanigan, Washoe County, for use at the company cement plant in Lyon County. In White Pine County, fire clay was obtained from the McDonough clay bed near Ely. The material was sold for use in refractories. The quantity of miscellaneous clays consumed was 14 percent more than in 1967. Sales of bentonite decreased 12 percent; the tonnage of fuller's earth sold remained about the same.

Diatomite.—Sales of prepared diatomite declined 6 percent in quantity but rose 7 percent in value compared with 1967 figures. No sales of crude materials were reported. As in 1967, four deposits were mined. Eagle-Picher Industries, Inc., remained the largest Nevada producer with its Celatom mine and filtration-media plant near Lovelock, Pershing County, and Tunnel Hill mine and Clark Siding plant east of Reno, Storey County. GREFCO, Inc., the second largest producer in Nevada, operated its mine at Basalt and plant near Mina, both in Esmeralda County. United Sierra Division of Cyprus Mines Corp. supplied small quantities of diatomite from its mine in Churchill County to its mill near Fernley, Lyon County. Product sales, in order of demand, were for filtration, fillers, and lightweight aggregate, and also included coating and fertilizer anticaking agents, carriers, insulation, and small amounts for abrasive. Eagle-Picher Industries, Inc., doubled the capacity of its Colado diatomite processing plant near Lovelock, Pershing County, by installing a second rotary furnace.

Fluorspar.—Both production and shipments of fluorspar declined for the second consecutive year. Ceramic and metallurgical grade fluorspar was produced and shipped from the J. Irving Crowell (Daisy) mine, Nye County, and Wells Cargo, Inc., reported shipments from stockpile at its Carp Spar property, Lincoln County. Operations at the Goldspar and Mary mines of Monolith Portland Cement Co., Nye County, were abandoned and all equipment was removed from the properties.

Gypsum.—More than 552,000 tons of gypsum was mined for use in Nevada and California in the manufacture of plaster and building products and as a retarder in portland cement. Output represented a 35-percent gain over that of 1967 and reflected an increase in demand for wallboard.

United States Gypsum Co. mined gypsum in Pershing County for use at its gypsum products plant in Washoe County. The Flintkote Co. and Johns-Manville Products Corp. mined gypsum in Clark County for use in their respective plants at Blue Diamond and Apex and for shipment by rail to plants in California. The three plants in Nevada calcined 303,000 tons of gypsum in 1968, compared with 233,000 tons in 1967. Registered sales of agricultural gypsum in Nevada totaled nearly 4,700 tons.

Lime.—The quantity of quicklime and hydrated lime sold or used was 15 percent greater than in 1967 and was the highest on record. Substantial increases were recorded in sales of lime for copper concentration, steel and paper manufacture, and construction uses. Nearly 93 percent of the total output was shipped to consumers in California, Washington, Oregon, seven other States, and Canada and Mexico. Consumers in Nevada used 45,300 tons of Nevada, California, and Utah lime.

U.S. Lime Division of the Flintkote Co. operated three plants in Clark County, producing quicklime at Apex, hydrated lime at Sloan, and both quicklime and hydrated lime at Henderson. Morrison and Weatherly Chemical Products Co. operated a plant at McGill in White Pine County, primarily to supply quicklime to Kennecott Copper Corp.

Lithium Compounds.—Lithium carbonate was produced at Silver Peak, Esmeralda County, by Foote Mineral Co. Additional brine wells and solar evaporation ponds had been installed in 1967. Production in 1968 was more than double the 1967 figure. The Silver Peak facility produced only lithium carbonate, but the company was planning to eventually obtain the raw materials for all its internal requirements for lithium metal, chemicals, and carbonate from the Silver Peak solar evaporation ponds.

Magnesite and Brucite.—Mine production of magnesite and brucite from open pit operations of Basic, Inc., near Gabbs, Nye County, increased over that of 1967. The company upgraded the ore in nearby plants, and most of the ore was consumed in the manufacture of special products and refractory materials. Some magnesite and brucite were sold to out-of-State customers. Combined consumption and shipments of all materials was higher than in 1967.

Perlite.—Crude perlite sales declined for the 11th consecutive year, and no sales of expanded material were reported. Combined Metals Reduction Co. (Hollinger pit) and Delamar Perlite (Mackie claims) mined perlite in Lincoln County, and shipped the crude material to out-of-State customers. Perlite was mined in Pershing County from the Pearl Hill quarry of United States Gypsum Co., and was expanded and used in the company wallboard plant in Washoe County.

Pumice (Volcanic Cinder).—The output of pumice, pumicite, volcanic cinders, and scoria was down 41 percent from that of 1967, primarily because of a smaller demand for the materials in road construction, fill, and concrete admixtures. Kemway Enterprises mined pumicite from the Lory Free pit, Lincoln County, and prepared the material for use as pozzolan. Rilite Aggregate Co. mined pumicite in Washoe County and sold the prepared material for concrete aggregate, roofing, and decorative use. Cind R Lite Co., Nye County, and Sierra Aggregates, Washoe County, both mined volcanic cinders, and prepared the crude material for concrete aggregate use. Volcanic cinders (scoria) from the Cinderlite Aggregates property of Savage Construction Co., Inc., Ormsby County, was prepared for concrete aggregate, acoustic plaster, fill, and road construction uses. Pumice from the Naturalite group claims, Storey County, was prepared for concrete aggregate use.

Salt.—Solar-evaporated salt was harvested from a dry lakebed near Sand Springs, Churchill County, and from ponds near Silver Peak, Esmeralda County. Most of the output was sold for use in ice control on roads by State, County, and local agencies in Nevada. Lesser quantities were used by meat packers, tanners, and dairies, and a small quantity was shipped to users in Idaho and California.

Sand and Gravel.—Production of sand and gravel totaled 7.8 million tons compared with 10.2 million tons in 1967. Demand for building and paving material was confined mainly to projects in the Reno and Las Vegas areas. Most of the highway construction projects in other parts of the State were either nearly completed or newly started.

There were 108 active sand and gravel operations, three less than in 1967. Of these, 44 were classified as commercial and 64 as Government-and-contractor. Total output by each of the two categories was

3.9 million tons. Two of the commercial operators produced over 500,000 tons each, 9 produced between 100,000 and 500,000 tons each, and 33, less than 100,000 tons each.

Producers of specialty silica sands near Overton, Clark County, reported increased outputs for glass, molding, foundry, and other industrial applications.

Stone.—Total output of quarried stone was virtually unchanged from that in 1967. Most of the production occurred in Clark, Lyon, and Washoe Counties.

Limestone was quarried in Clark County for use in refining sugar, as metallurgical flux, and in making lime; in Lyon County for making cement; in White Pine County for lime and flux; and in Pershing County

Table 10.—Sand and gravel production in 1968, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Churchill	344	$355
Clark	4,092	5,586
Douglas	10	11
Elko	92	122
Esmeralda	2	2
Eureka	7	8
Humboldt	102	137
Lander	9	7
Lincoln	12	14
Lyon	174	262
Mineral	16	16
Nye	172	251
Ormsby	781	795
Pershing	79	69
Washoe	1,869	2,765
White Pine	51	42
Total	7,812	10,442

Table 11.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Glass	W	W	W	W
Molding	W	W	W	W
Building	594	$1,229	687	$1,441
Paving	162	296	230	282
Railroad ballast	(1)	1	W	W
Fill	111	116	143	118
Other	185	72	145	259
Gravel:				
Building	380	752	837	1,451
Paving	1,084	1,104	1,088	1,284
Railroad ballast	1	2	W	W
Fill	222	225	358	335
Other	W	W	W	W
Miscellaneous	357	582	247	485
Undistributed sand and gravel [2]	174	750	210	926
Total sand and gravel	3,220	5,079	3,945	6,576
Government-and-contractor operations:[3]				
Sand:				
Building	1	1	--------	--------
Paving	126	124	88	95
Fill	10	11	8	5
Other	10	10	24	24
Total	147	146	120	124
Gravel:				
Building	1	1	--------	--------
Paving	6,633	3,257	3,617	3,618
Fill	132	130	36	30
Other	33	31	94	94
Total	6,799	3,419	3,747	3,742
Total sand and gravel	6,946	3,565	3,867	3,866
All operations:				
Sand	1,321	2,608	1,529	3,129
Gravel	8,845	6,036	6,283	7,313
Grand total	10,166	8,644	7,812	10,442

W Withheld to avoid disclosing individual company confidential data.

[1] Less than ½ unit.

[2] Includes fire or furnace sand, other industrial (unground) sand, and items indicated by symbol W

[3] Includes figures for State, counties, municipalities, and other Government agencies.

for agriculture. Terrazzo was produced at a marble quarry in Mineral County. Calcareous marl for mineral filler was quarried in Nye and Washoe Counties. Dimension stone for building, monument, and flagging uses was produced in White Pine and Lyon Counties. A stone quarry in Eureka County was a source of railroad ballast. Government crews and contractors processed stone in Washoe and other counties for roadbase and road-surface maintenance uses.

Talc and Soapstone.—Talc and soapstone production was up nearly 45 percent over that of 1967. Sales also were higher, and all shipments were made to out-of-State grinding plants. As in preceding years, all of the production came from deposits in Esmeralda County. Talc was produced from the Hideout claims near the California State line and from the Wellington talc property in the Goldfield area. Chas. Pfizer & Co., Inc., mined soapstone at the White Top deposit. The Oasis mine of Cyprus Mines Corp. was idle throughout the year.

MINERAL FUELS

Petroleum.—Oil production from the Eagle Springs field in Nye County dropped about 3 percent, continuing a decline from the high recorded in 1966. There were 13 producing wells at yearend. The Nevada Oil and Gas Conservation Committee issued 17 well-drilling permits, six more than in 1967. Two of the 17 wells had not been completed at yearend; the others were dry holes. Drilling activity was concentrated in the vicinity of the Eagle Springs field where one well was drilled on the west edge of the field by Texota Oil Co., and 12 wells were drilled north and east of the field in northeastern Nye County and southwestern White Pine County. Exploratory drilling was conducted primarily by Gulf Oil Corp. with eight test wells and by Pan American Petroleum Corp. with four wells.

The small refinery at the Eagle Springs field was destroyed by fire in November and salvage operations were being conducted at yearend.

Table 12.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1968

County	Drilling [1]							
	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Elko	----	----	----	----	----	1	1	5,284
Eureka	----	----	----	----	----	1	1	3,117
Nye	----	----	1	----	----	12	13	79,224
Total	----	----	1	----	----	14	15	87,625

[1] Does not include two wells (12,000 feet) standing suspended at yearend.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Barite:			
Baroid Division, National Lead Co.	P.O. Box 1675 Houston, Tex. 77001	Open pit mine	Elko.
D. A. Mining Co.	P.O. Box 94 Battle Mountain, Nev. 89820	do	Lander.
Dresser Minerals	P.O. Box 6504 Houston, Tex. 77005	do	Do.
FMC Corp	P.O. Box 8808 Modesto, Calif. 95352	do	Do.
Milchem, Inc	Box 22111 Houston, Tex. 77027	do	Do.
Tom Norris	P.O. Box 129 Battle Mountain, Nev. 89820	do	Do.
Cement:			
Nevada Cement Co	Fernley, Nev. 89408	Dry process portland cement plant	Lyon.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays:			
Nevada Cement Co	Fernley, Nev. 89408	Open pit mine	Washoe.
Western Talc Co	P.O. Box 368 Yermo, Calif. 92398	do	Clark, Esmeralda, Nye.
Copper:			
The Anaconda Company	P.O. Box 1000 Weed Heights, Nev. 89443	do	Lyon.
Cliffs Copper Corp., & Associates, Ltd.	Rifle, Colo. 81650	do	Elko.
Duval Corp	P.O. Box 451 Battle Mountain, Nev. 89820	do	Lander.
Kennecott Copper Corp. Nevada Mines Div.	McGill, Nev. 89818	do	White Pine.
Diatomite:			
Eagle-Picher Industries, Inc	P.O. Box 1869 Reno, Nev. 89505	do	Pershing, Storey.
GREFCO, Inc	630 Shatto Place Los Angeles, Calif. 90005	do	Esmeralda.
The United Sierra Division Cyprus Mines Corp.	P.O. Box 1201 Trenton, N.J. 08606	do	Churchill.
Fluorspar:			
J. Irving Crowell, Jr	P.O. Box 96 Beatty, Nev. 89003	Underground mine	Nye.
Wells Cargo, Inc	P.O. Box 14037 Las Vegas, Nev. 89114	do	Lincoln.
Gold:			
Carlin Gold Mining Co	P.O. Box 672 Elko, Nev. 89801	Open pit mine	Eureka.
Duval Corp	P.O. Box 451 Battle Mountain, Nev. 89820	do	Lander.
Kennecott Copper Corp. Nevada Mines Division.	McGill, Nev. 89818	do	White Pine.
Gypsum:			
The Flintkote Co	P.O. Box 2678 Terminal Annex Los Angeles, Calif. 90054	do	Clark.
Johns-Manville Products Corp.	215 Market Street, Rm. 916 San Francisco, Calif. 94105	do	Do.
United States Gypsum Co	101 So. Wacker Dr. Chicago, Ill. 60606	do	Pershing.
Iron ore:			
Cooney Bros	P.O. Box 568 Lovelock, Nev. 89419	do	Do.
Nevada Barth Corp	Carlin, Nev. 89822	do	Eureka.
Nevada Iron Ore Co., Inc	945 Cornell Ave. Lovelock, Nev. 89419	do	Pershing.
Standard Slag Co	Box 4400 Reno, Nev. 89501	do	Douglas.
Lead:			
Farrow Brothers	Gold Creek, Nev. 89000	Underground mine	Elko.
Federal Resources Corp	1370 South 3rd West Salt Lake City, Utah 84115	do	Mineral.
Grand Deposit Mining Co., & Combined Metals Reduction Co.	Pioche, Nev. 89043	do	Lincoln.
Lime:			
The Flintkote Co	P.O. Box 57367 Flint Station Los Angeles, Calif. 90057	Rotary kilns, batch and continuous hydrators.	Clark.
Morrison & Weatherly Chemical Products.	Box 1105 McGill, Nev. 89318	Rotary kilns	White Pine.
Lithium:			
Foote Mineral Co	Route 100 Exton, Pa. 19341	Dry lake brines	Esmeralda.
Magnesite:			
Basic, Inc	845 Hanna Bldg. Cleveland, Ohio 44115	Open pit mine	Nye.
Mercury:			
Crofoot Lumber Co	Rt. 2, Box 625 B Ukiah, Calif. 95482	Underground mine	Pershing.
Horton Bros. Mining Co	Hwy. 40 East Winnemucca, Nev. 89445	Open pit mine	Do.
Kollsman Mineral & Chemical Co.	1441 Angelo Drive Beverly Hills, Calif. 90210	do	Esmeralda.
Fred H. Lenway & Co., Inc	100 California St. San Francisco, Calif. 94111	Underground mine	Humboldt.
Old West Enterprises, Inc	501 Moana Lane #58 Reno, Nev. 89502	Open pit mine	Washoe.
Star City Mines, Ltd	P.O. Box 1008 Winnemucca, Nev. 89445	do	Pershing.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Molybdenum:			
Kennecott Copper Corp., Nevada Mines Division.	McGill, Nev. 89318	Open pit mine	White Pine.
Perlite:			
Combined Metals Reduction Co., Panacalite Division.	218 Felt Bldg. Salt Lake City, Utah 84110	do	Lincoln.
Delamar Perlite	Pioche, Nev. 89043	Underground mine	Do.
United States Gypsum Co	101 So. Wacker Drive Chicago, Ill. 60606	Open pit mine	Pershing.
Petroleum:			
North American Resources Corp.	811 San Jacinto Bldg. Houston, Texas 77002	Producing crude oil wells	Nye.
Western Oil Lands, Inc	380 Linden Street Reno, Nev. 89502	do	Do.
Pumice:			
Cind R Lite Co	3333 Cinder Lane Las Vegas, Nev. 89103	Open pit mine	Nye.
Kaiser Industries Corp	300 Lakeside Drive Oakland, Calif. 94612	do	Storey.
Rilite Aggregate Co	P.O. Box 5665 Reno, Nev. 89503	do	Washoe.
Savage Construction Inc	P.O. Box 970 Carson City, Nev. 89701	do	Ormsby.
Salt:			
Fallon Development Co	Harrigan Rd. Fallon, Nev. 89406	Dry lake brines	Churchill.
Sand and gravel:			
A-1 Paving Co	3346 Ellis Las Vegas, Nev. 89102	Open pit mine	Clark.
Asphalt Products Corp	1770 Industrial Road Las Vegas, Nev. 89502	do	Do.
Dayton Sand & Gravel Co	P.O. Box 193 Dayton, Nev. 89403	do	Lyon.
John Etchart	426 Bridge Street Winnemucca, Nev. 89445	do	Humboldt.
George Grifall Co., Inc	385 Grifall Avenue Sparks, Nev. 89431	do	Washoe.
R. Helms Construction Co	3025 Mill Street Reno, Nev. 89502	do	Do.
Las Vegas Building Materials Inc.	P.O. Box 530 Las Vegas, Nev. 89101	do	Clark.
Nevada Aggregates & Asphalt.	P.O. Box 7424 Reno, Nev. 89502	do	Washoe.
Simplot Silica Products	P.O. Box 308 Overton, Nev. 89040	do	Clark.
Stewart Brothers Co	P.O. Box 2775 Huntridge Sta. Las Vegas, Nev. 89101	do	Do.
Stock Mill & Supply Co	3336 Cinder Lane Las Vegas, Nev. 89103	do	Do.
A. Teichert & Sons, Inc	P.O. Box 825 Sparks, Nev. 89431	do	Washoe.
W.M.K. Transit Mix, Inc	1606 Industrial Road Las Vegas, Nev. 89102	do	Clark.
Wells-Cargo, Inc	14037 Mountain Road Las Vegas, Nev. 89114	do	Do.
Silver:			
John F. Ala	P.O. Box 55 Montello, Nev. 89830	Underground mine	Elko.
Duval Corp	P.O. Box 451 Battle Mountain, Nev. 89820	Open pit mine	Lander.
Federal Resources Corp	1370 South 3rd West Salt Lake City, Utah 84115	Underground mine	Mineral.
Grand Deposit Mining Co., & Combined Metals Reduction Co.	Pioche, Nev. 89043	do	Lincoln.
Kennecott Copper Corp., Nevada Mines Division.	McGill, Nev. 89318	Open pit mine	White Pine.
Terex Corp	P.O. Box 1106 Carson City, Nev. 89701	do	Douglas.
Stone:			
Hatch Rock Quarries, Inc	P.O. Box 765 Mountain View, Calif. 94040	Open quarry	White Pine.
Morrison & Weatherly Chemical Products.	Box 1105 McGill, Nev. 89318	do	Do.
Nevada Cement Co	Fernley, Nev. 89408	do	Lyon.
Sonora Aggregates Co., Division of Grassi American Co.	111 S. Maple St. So. San Francisco, Calif. 94080	do	Mineral.
U.S. Lime Division The Flintkote Co.	P.O. Box 57367 Flint Station, Los Angeles, Calif. 90057	do	Clark.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Talc and soapstone:			
Chas. Pfizer & Co., Inc	P.O. Drawer AD Victorville, Calif. 92394	Open pit mine	Esmeralda.
Tungsten:			
Meissner, Hess and Sandoval	Box 203 Lovelock, Nevada 89419	do	Pershing.
Quicktung Mining Co., Inc	P.O. Box 293 Fallon, Nev. 89406	Underground and open pit mine	Churchill.
Zinc:			
Federal Resources Corp	1370 South 3rd West Salt Lake City, Utah 84115	Underground mine	Mineral.
Grand Deposit Mining Co., & Combined Metals Reduction Co.	Pioche, Nev. 89043	do	Lincoln.
M.I.A. Mines Co	P.O. Box 150 Salt Lake City, Utah 84110	do	Eureka.

The Mineral Industry of New Hampshire

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the New Hampshire Department of Resources and Economic Development for collecting information on all minerals except fuels.

By William Cochran [1]

The value of mineral production increased nearly 13 percent to almost $9.2 million in 1968. The increase was due primarily to greater demand by the building construction industry for processed sand and gravel and dimension granite; however, the value increase was limited by reduced demand for aggregate caused by less highway construction. Minerals used in construction accounted for 94 percent of the total output value.

Table 1.—Mineral production in New Hampshire[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ... thousand short tons	42	$42	41	$41
Mica (sheet) ... pounds	16,000	W	--------	--------
Peat ... short tons	50	(2)	--------	--------
Sand and gravel ... thousand short tons	8,449	5,137	7,742	5,698
Stone ... do	473	2,887	383	3,377
Value of items that cannot be disclosed: Feldspar, gem stones, and value indicated by symbol W	XX	51	XX	50
Total	XX	8,117	XX	9,166
Total ... 1957–59 constant dollars	XX	7,828	XX	^{p}8,780

^{p} Preliminary. XX Not applicable.

W Withheld to avoid disclosing individual company confidential data.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Less than ½ unit.

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[1] Geologist, Bureau of Mines, Pittsburgh, Pa.

Table 2.—Value of mineral production in New Hampshire, by counties

(Thousand dollars)

County	1967	1968	Minerals produced in 1968 in order of value
Belknap	W	W	Sand and gravel, stone.
Carroll	W	W	Sand and gravel, stone.
Cheshire	W	W	Do.
Coos	$343	$220	Do.
Grafton	924	803	Sand and gravel, stone, feldspar, clays.
Hillsboro	2,528	2,952	Stone, sand and gravel.
Merrimack	1,914	2,333	Sand and gravel, stone.
Rockingham	856	1,192	Sand and gravel, stone, clays.
Strafford	242	W	Sand and gravel, clays.
Sullivan	W	W	Sand and gravel, stone.
Undistributed [1]	1,310	1,666	
Total	8,117	9,166	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes value of sand and gravel and gem stones not assigned to specific counties and values indicated by symbol W.

Table 3.—Indicators of New Hampshire business activity

	1967	1968	Change (percent)
Employment and labor force, annual average:			
Total labor force ... thousands	287.7	293.1	+1.9
Unemployment ... percent of work force	2.0	p 1.9	−5.0
Employment:			
Manufacturing employment ... thousands	97.6	p 99.7	+2.2
Durable goods ... do	45.8	p 46.2	+.9
Nondurable goods ... do	51.8	p 53.5	+3.3
Nonmanufacturing employment ... do	146.8	p 151.4	+3.1
Mining and construction ... do	12.1	p 11.8	−1.2
Average weekly earnings of production workers:			
Manufacturing	$91.71	p $97.14	+5.9
Durable goods	$94.76	p $101.46	+7.0
Nondurable goods	$88.93	p $93.91	+5.6
Personal income:			
Total ... millions	$2,094	$2,294	+9.5
Per capita	$3,031	p $3,268	+7.8
Construction activity:			
Highway construction contracts ... thousands	$32,864	$17,234	−47.6
Residential building permits ... do	$54,290	$61,044	+12.4
Cement shipments to and within New Hampshire thousand 376-pound barrels	915	1,036	+13.2
Mineral production ... thousands	$8,117	$9,166	+12.9

p Preliminary.

Sources: New Hampshire Department of Public Works and Highways; New Hampshire Department of Employment Security; and U.S. Bureau of the Census.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Nonmetals and peat	48	264	13	101	----	3	29.73	208
Sand and gravel	384	214	82	708	----	16	22.59	418
Stone	162	246	40	322	----	7	21.76	603
Total	594	227	135	1,131	----	26	22.99	452
1968: p								
Nonmetals	45	314	15	118	----	1	8.47	17
Sand and gravel	375	204	77	660	----	14	21.21	924
Stone	120	245	30	237	----	4	16.85	438
Total	545	223	121	1,016	----	19	18.71	705

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—Clay from pits operating in Grafton, Rockingham, and Strafford Counties was used primarily in manufacturing building bricks. Total value and production of clay each declined 2 percent from that of the previous year. Production has declined each year since 1965, when 53,200 tons was produced. This decline is contrary to an upward trend by most economic indicators, including building construction.

Feldspar.—Bell Minerals Co. operated the Ruggles mine in Grafton County. Ore was selectively mined, hand sorted, and shipped by truck to a grinding mill at West Paris, Maine. Unit value of crude ore decreased, but increased production caused the total value to exceed that of the previous year. Major uses for the finely ground feldspar were in ceramics and as an abrasive in cleaning compounds.

Gem Stones.—Amateur collectors and dealers collected mineral specimens primarily in Carroll, Cheshire, and Grafton Counties. Areas associated with pegmatites and mine workings were the source of semiprecious gem stones and other mineral specimens. Material collected included beryl, amethyst, smoky quartz, and topaz crystals.

Mica.—In previous years, the Ruggles Mine in Grafton County had been the source of small quantities of block mica. No mica was produced at this mine in 1968.

Peat.—A small quantity of previously processed peat was sold in 1967, but none was reported produced or sold in 1968.

Perlite.—Expanded perlite for use in acoustical plaster was produced by National Gypsum Co. at its plant in Portsmouth. Raw material was imported from the Western States. Unit value of the processed material was about the same as in the previous year, however, there was a small increase in total production and value. This value is not included in table 1 of this chapter.

Sand and Gravel.—Compared with that of 1967, total output of sand and gravel declined 8 percent, but total value increased 11 percent. Output from Government-and-contractor operations supplying material for highway construction dropped sharply, while that from commercial operations increased 23 percent in volume and 32 percent in value. Commercial operators not only increased production but washed and screened proportionately more material than in the previous year. Average values for washed and bank-run material increased during 1968 to $1.13 and $0.60 per ton, respectively. Of the 32 commercial operators reporting production in 1968, 12 had an output of less than 50,000 tons, seven produced 50,000 to 100,000 tons, and 13 produced over 100,000 tons each. Some of the commercially produced material was shipped by rail to Boston, Mass., for use in ready-mix concrete.

Table 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	580	$503	673	$592
Paving	544	422	607	554
Fill	551	268	834	579
Other [1]	103	99	51	39
Total	1,778	1,292	2,165	1,764
Gravel:				
Building	646	833	822	1,108
Paving	820	914	1,013	1,153
Fill	204	100	156	77
Other [2]	159	156	293	248
Total	1,829	2,003	2,284	2,586
Total sand and gravel	3,607	3,295	4,449	4,350
Government-and-contractor operations:				
Sand:				
Paving	2,161	767	1,225	486
Fill	20	7	18	6
Total	2,181	774	1,243	494
Gravel: Paving	2,661	1,068	2,050	854
Total sand and gravel [3]	4,842	1,843	3,293	1,350
All operations:				
Sand	3,959	2,066	3,408	2,258
Gravel	4,490	3,071	4,334	3,440
Total [3]	8,449	5,137	7,742	5,698

[1] Includes filtration sand (1968), engine sand, and sand for other construction and industrial uses.
[2] Includes miscellaneous gravel.
[3] Data may not add to totals shown because of independent rounding.

Stone.—Total value of stone production increased 17 percent compared with that of 1967. Production consisted of various types of dimension granite, crushed granite and miscellaneous stone, and crushed quartz. Reductions occurred in the value of crushed quartz as well as crushed granite and miscellaneous stone, but since these types of stone account for a minor part of total stone value, the reduction had little effect. Dimension granite, which accounts for most stone value, had an increase of 31 percent in 1968.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Clay:			
Densmore Brick Co	Lebanon, N.H. 03766	Pit	Grafton.
W.S. Goodrich, Inc	Epping, N.H. 03042	Pit	Rockingham.
The Kane-Gonic Brick Corp	Gonic, N.H. 03867	Pit	Strafford.
Feldspar (crude): Bell Minerals Co	West Paris, Maine 04289	Underground open pit.	Grafton.
Gypsum (calcined): National Gypsum Co.	325 Delaware Ave., Buffalo, N.Y. 14202	Plant	Rockingham.
Perlite (expanded): National Gypsum Co.	325 Delaware Ave., Buffalo, N.Y. 14202	do	Do.
Sand and gravel:			
Campton Sand & Gravel, Inc	P.O. Box 2 W. Campton. N.H. 03228	Pit	Grafton.
Cold River Sand & Gravel Corp.	P.O. Box 429 Bellows Falls, Vt. 05101	Pit	Cheshire.
J.J. Cronin Company	P.O. Box 176 N. Reading, Mass. 01864	Pit	Hillsboro.
Keene Sand & Gravel, Inc	725 Main Street Keene, N.H. 03431	Pit	Cheshire.
Lebanon Crushed Stone	Plainfield Rd., W. Lebanon, N.H. 03784	Pit	Grafton.
Manchester Sand, Gravel & Cement Co., Inc.	P.O. Box 415 Hooksett, N.H. 03106	Pit	Merrimack and Rochingham.
McKay & Wright	Milford, N.H. 03055	Pit	Hillsboro.
Nashua Sand & Gravel	Route 130 Nashua, N.H. 03060	Pit	Do.
Thomopoulis Sand & Gravel Pit.	Londonderry, N.H. 03053	Pit	Rockingham.
Tilton Sand & Gravel, Inc	Tilton, N.H. 03276	Pit	Belknap.
Twin States Sand & Gravel	P.O. Box 203 W. Lebanon, N.H. 03784	Pit	Grafton.
Stone:			
Granite, dimension:			
Kitledge Granite Corp	Oak Street Milford, N.H. 03055	Quarry	Hillsboro.
The John Swenson Granite Co., Inc.	North State Street, Concord, N.H. 03301	do	Merrimack.
Miscellaneous stone, crushed:			
Iafolla Crushed Stone, Co., Inc.	Peverly Hill Rd., Portsmouth, N.H. 03801	do	Rockingham.
Lebanon Crushed Stone, Inc.	Plainfield Rd., W. Lebanon, N.H. 03784	do	Grafton.
Quartz, crushed:			
North Country Aggregates, Inc.	P.O. Box 55, S. Lyndeboro, N.H. 03082	do	Hillsboro.
Quartz, Inc	P.O. Box 234 Keene, N.H. 03431	do	Sullivan.

The Mineral Industry of New Jersey

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the New Jersey Division of Resource Development, Bureau of Geology and Topography, for collecting information on all minerals except fuels.

By Richard J. Leary [1]

The value of mineral production in New Jersey increased $4.7 million over that of 1967, paced by a $5.7 million gain in total sand and gravel and stone production. Other nonmetallics, metals, and fuels collectively declined about $1 million. Similar patterns were evident in the average unit values reported: Sand and gravel and stone advanced 3 percent; zinc and its manganiferous residuum held at the same level; other minerals declined from 1 to 12 percent in average unit value.

A continuing high level of construction activity, particularly for highways, enlarged the demand for concrete aggregate materials: Sand and gravel, stone and cement. Housing starts declined sharply, adversely affecting the demand for clay products, particularly building brick. Zinc production declined again this year.

Mineral producers were active in all counties except Salem. Somerset County maintained its lead in mineral production, followed by Sussex and Cumberland Counties. More than $10 million of mineral production was reported for each of these three counties; together they accounted for more than one-half of New Jersey's mineral industry.

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[1] Metallurgist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in New Jersey [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ---- thousand short tons	437	$1,189	373	$1,008
Gem stones	NA	10	NA	10
Peat ---- short tons	43,045	542	55,786	621
Sand and gravel ---- thousand short tons	18,626	29,975	20,306	33,570
Stone ---- do	12,611	28,253	13,151	30,343
Zinc [2] (recoverable content of ores, etc.) ---- short tons	26,041	7,031	25,668	6,930
Value of items that cannot be disclosed:				
Iron ore (1967), lime, magnesium compounds, manganiferous residuum, greensand marl, and titanium concentrate (ilmenite)	XX	5,747	XX	4,984
Total	XX	72,747	XX	77,466
Total 1957–59 constant dollars	XX	68,747	XX	p 72,571

p Preliminary. NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Recoverable zinc valued at yearly average price of Prime Western slab zinc, East St. Louis market. Represents value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

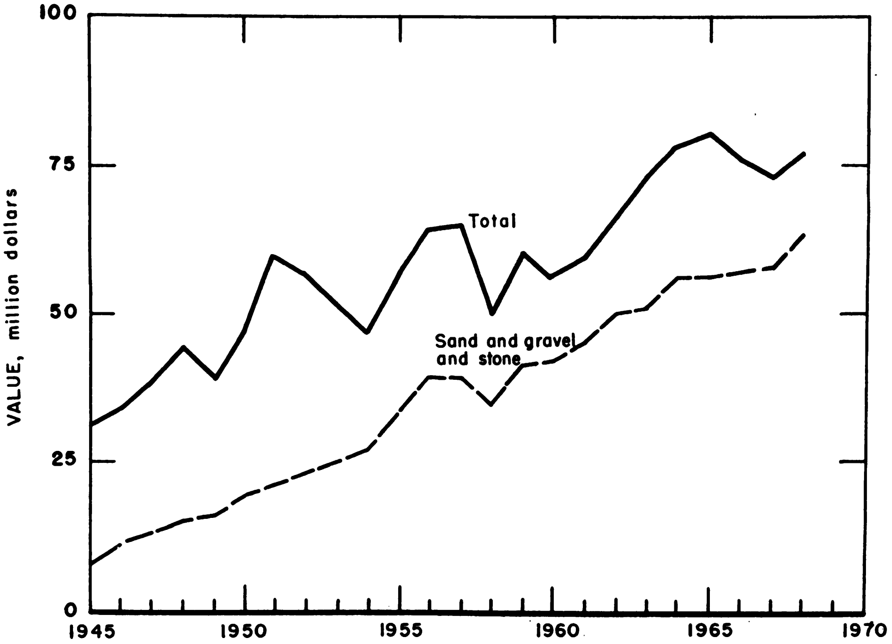

Figure 1.—Value of sand and gravel and stone, and total value of mineral production in New Jersey.

Table 2.—Value of mineral production in New Jersey, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Atlantic	$399	$617	Sand and gravel.
Bergen	W	W	Sand and gravel, clays.
Burlington	1,994	2,829	Do.
Camden	2,097	2,218	Do.
Cape May	W	W	Magnesium compounds, sand and gravel.
Cumberland	10,795	12,520	Sand and gravel, clays.
Essex	W	W	Stone.
Gloucester	476	478	Sand and gravel, greensand marl, stone.
Hudson	W	W	Stone.
Hunterdon	1,229	W	Do.
Mercer	W	W	Do.
Middlesex	2,516	2,484	Sand and gravel, clays.
Monmouth	1,128	1,145	Sand and gravel.
Morris	6,603	6,347	Sand and gravel, stone.
Ocean	4,637	5,059	Sand and gravel, ilmenite.
Passaic	5,268	5,175	Stone, sand and gravel.
Somerset	13,111	14,505	Stone, clays.
Sussex	12,622	12,771	Zinc, stone, manganiferous residuum, sand and gravel, lime, peat.
Union	W	W	Stone.
Warren	974	880	Sand and gravel, peat, stone.
Undistributed[2]	8,897	10,436	
Total[3]	72,747	77,466	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] No production reported in Salem County.

[2] Includes value of gem stones and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of New Jersey business activity

		1967	1968	Change (percent)
Employment and labor force, annual average: [1]				
Total work force	thousands	2,855.2	2,909.9	+1.9
Unemployment	(percent of work force)	4.5	4.6	+2.2
Employment	thousands	2,722.4	2,771.9	+1.8
Manufacturing	do	882.1	885.9	+.4
Durable goods	do	464.0	461.1	−.6
Stone, clay and glass products	do	39.1	38.8	−.8
Primary metals industries	do	38.5	38.6	+.3
Fabricated metals	do	65.4	66.9	+2.3
Machinery (excluding electric)	do	75.0	75.5	+.7
Electrical machinery	do	131.5	129.1	−1.8
Transportation equipment	do	32.0	31.9	−.3
Instruments	do	36.5	35.5	−2.7
Other durables	do	46.0	44.8	−2.6
Nondurable goods	do	418.1	424.8	+1.6
Nonmanufacturing	do	1,539.1	1,601.5	+4.1
Mining	do	2.8	3.0	+7.1
Construction	do	111.0	114.1	+2.8
Transportation and public utilities	do	165.8	166.4	+.4
Wholesale and retail	do	472.9	492.8	+4.2
Finance, insurance, real estate	do	106.0	109.7	+3.5
Service	do	351.6	372.2	+5.9
Government	do	329.0	343.3	+4.3
Payroll data: [2]				
Average weekly earnings (manufacturing)		$118.96	$125.76	+5.7
Personal income: [3]				
Total	millions	$25,686	$27,711	+7.8
Per capita		$3,679	[p] $3,907	+6.2
Construction activity:				
New housing units (authorized)[4]		46,344	39,753	−14.2
Cement (portland) shipments to New Jersey [5]	thousand 376-pound barrels	9,855	10,312	+4.6
Mineral production [5]	thousands	$72,747	$77,466	+6.5

[p] Preliminary.
[1] Source: New Jersey Department of Labor and Industry, Bureau of Employment.
[2] Source: Employment and Earnings, U.S. Department of Labor.
[3] Source: Survey of Current Business.
[4] Source: Construction Reports, U.S. Department of Commerce.
[5] Source: Bureau of Mines.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Peat	21	204	4	34	------	------	------	-------
Metal	185	282	52	417	------	22	52.71	1,706
Nonmetal	295	239	71	565	------	17	30.07	867
Sand and gravel	1,114	245	273	2,274	1	45	20.23	3,219
Stone	856	259	222	1,846	1	57	31.41	4,009
Total [1]	2,471	252	622	5,137	2	141	27.84	3,100
1968: [p]								
Peat	21	215	5	36	------	------	------	-------
Metal	175	295	51	413	1	22	55.69	15,627
Nonmetal	355	235	83	664	------	20	30.13	568
Sand and gravel	1,045	245	255	2,104	------	56	26.62	781
Stone	985	261	257	2,159	------	68	31.49	1,220
Total [1]	2,575	253	651	5,376	1	166	31.06	2,066

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Shipments into New Jersey totaled 10.3 million barrels of portland cement (including 466,000 barrels of high-early cement) and 623,000 barrels of masonry cement. By comparison with 1967 levels, total shipments increased: Portland cement was up 4.7 percent, high-early down 6.2 percent, and masonry, up 1.8 percent. More than three-fourths of the portland cement shipments came from plants in eastern Pennsylvania; the balance came from eastern New York. Heretofore, limited quantities were received from States to the south, especially Maryland and Texas, but no shipments from these States were reported in 1968. Five distribution terminals were operated: Two in Jersey City, and one each in Bayonne, Elizabethport, and Newark.

Clays.—Production has been declining since 1965 and the trend continued in 1968. Production decreased 14.6 percent in tonnage and 15.2 percent in value from that of 1967. Both fire clay and miscellaneous clay and shale were affected. Fire clay continued to account for 23 percent of the tonnage, but contributed 62 percent of the value. Plastic fire clay was mined at four pits in Middlesex County and one in Cumberland County. Fire clay was used mainly in the traditional use pattern of refractory products, pottery, and fillers, but this year expanding recreational uses were noted: a race track, a lake bottom, along with ball fields and tennis courts. Miscellaneous clay and shale was produced mainly in Somerset and Middlesex Counties, and to a lesser degree in Bergen, Burlington, and Camden Counties. It was converted into building brick by seven producers; one other produced vitrified sewer pipe.

Gem Stones.—By all accounts mineral collectors continued to prospect quarries and old mine dumps throughout the State for mineral specimens. The value of the minerals collected was estimated at the same level as that of 1967.

Gypsum.—Crude gypsum was calcined at four plants, two in Burlington County, and one each in Bergen and Camden Counties. Calcined gypsum production totaled 356,000 tons, a 3-percent increase from 1967 production. Output was almost entirely in the form of prefabricated gypsum products, of which wallboard accounted for 95 percent. The remainder was distributed among lath and sheathing products.

Iodine.—Chemical and pharmaceutical manufacturers reported consumption of 631,000 pounds of iodine in 1968. This rate of consumption is a 5.6-percent gain over that of 1965, the previous high in the most recent 5-year period. Inorganic chemicals produced by five manufacturers continued to account for most of the total iodine used. The remainder was consumed by five producers of organic compounds.

Lime.—Hydrated lime production increased both in quantity and value for the second consecutive year. Output by one company in Sussex County was used in construction, agricultural applications, sewage treatment, and water purification.

Magnesium Compounds.—Compared with that of 1967, refractory magnesia production was about the same, but a lower average unit value was reported. Refractory magnesia was produced in Cape May County from out-of-State dolomite and sea water. A chemical plant in Warren County converted purchased materials to a variety of magnesium compounds.

Marl, Greensand.—Production increased slightly over that of 1967, but value declined because of lower unit prices. Output of the material (natural zeolite) was limited to one operation in Gloucester County and was used for water softening.

Perlite.—Crude perlite mined in Western States was processed at three plants, one each in Mercer, Middlesex, and Somerset Counties. The Burlington plant of National Gypsum Co. was idle. Shipments increased both in quantity and value over those of 1967. Principal uses were in building plaster, concrete aggregate, soil conditioners, and building shingles.

Pigments.—Iron oxide pigments were produced by E. I. du Pont de Nemours & Co. Inc., Newark, and Columbian Carbon Co., Trenton and Monmouth Junction. Stabilized Pigments, Inc., New Brunswick, discontinued iron oxide pigment production. Titanium dioxide pigments were produced by The New Jersey Zinc Co., Gloucester City, and by National Lead Co., Perth Amboy, which also manufactured lead pigments. Royce Chemical Co., Carlton Hill, manufactured zinc oxide and lead-zinc oxide pigments.

Sand and Gravel.—Growth in highway and building construction markets led sand and gravel production to a 9-percent gain in output over that of 1967. Highway uses increased 17 percent, building uses 9 percent, and industrial uses rose 8 percent. Average unit value of sand and gravel for these uses likewise increased: Sand increased 2.1 percent, gravel 3.7 percent, and, combined 2.7 percent. Output of sand and gravel for fill declined 10 percent, but unit value remained relatively stable. All of the production was by commercial operators. Sand and gravel for building, paving, and fill totaled 16.5 million tons, 81 percent of the total output, but this market accounted for only 56 percent of the total value. Above-average gains in output were reported for molding and glass sands.

Sand and gravel producers were active in 14 of the State's 21 counties. Production exceeded 1 million tons in seven counties. Morris County continued to lead in tonnage, producing 3.5 million tons. Cumberland ranked first in value; its industrial sand accounted for more than one-third of the total value of sand and gravel produced in the State.

The number of commercial operations increased to 114 (109 in 1967). The scale of production also increased. Eleven operators produced more than 500,000 tons; their combined production was 38 percent of the total. Median production was about 125,000 tons. About 17.8 million tons of sand and gravel was processed by washing, crushing, sizing, or screening. Shipments were primarily by truck (16.3 million tons). Plants were mainly of the stationary type, but three portable plants and 18 dredges were reported in operation.

Stone.—As a result of growing demand for stone aggregate in highway construc-

Table 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	5,173	$5,349	5,955	$6,001
Paving	3,570	3,557	4,266	4,598
Fill	1,358	578	1,401	675
Glass	1,031	4,136	1,123	4,579
Molding	1,672	5,269	1,857	6,322
Blast	150	705	134	713
Ground	130	1,209	138	1,313
Other [1]	384	1,282	382	1,344
Total	13,468	22,085	15,256	25,545
Gravel:				
Building	2,862	5,196	2,785	5,142
Paving	1,532	1,938	1,713	2,271
Fill	558	501	330	256
Other [2]	190	249	222	356
Total	5,142	7,884	5,050	8,025
Total sand and gravel	18,610	29,969	20,306	33,570
Government-and-contractor operations:				
Gravel:				
Paving	14	5	--------	--------
Fill	2	1	--------	--------
Total	16	6	--------	--------
All operations:				
Sand	13,468	22,085	15,256	25,545
Gravel	5,158	7,890	5,050	8,025
Total	18,626	29,975	20,306	33,570

[1] Includes fire or furnace, engine, filtration, oil (1967), and other sand.
[2] Includes miscellaneous and other gravel.

tion, production of stone increased 4.3 percent in quantity and 7.4 percent in value. The market for aggregates has risen 14 percent in the last 2 years and now accounts for 90 percent of stone production. In the same time span, the riprap and jetty markets, the second largest use for stone, have fallen off by more than half. Other uses continue to provide a steady but slowly growing demand for stone.

Stone production was reported in 11 counties, led by Somerset, Passaic, Sussex, and Hudson Counties, in decreasing order of value. Production exceeded 1 million tons in four counties. Continued growth in output occurred in Hunterdon, Somerset, and Sussex Counties, mainly as a result of increased production of basalt (traprock) and granite. Types of stone produced included basalt, granite, limestone, marble, oystershell, sandstone, and miscellaneous stone.

Basalt continued to be the principal type of stone quarried; it provided 85 percent of the quantity and 80 percent of the value of all stone produced. Basalt was quarried in seven counties at 21 locations by 14 producers. Output was 5 percent greater than in 1967; average value also increased, from $2.12 per ton to $2.17. Somerset, Passaic, and Hudson were the leading counties; in each, production exceeded 1 million tons. Quarries were also active in Essex, Hunterdon, Mercer, and Union Counties. Ninety-three percent of the output was used as concrete aggregate, but riprap, railroad ballast, and filler material markets also were served.

Crushed limestone continued to rank second in value among the types of stone produced. Output was 6 percent greater than that of 1967 and average value per ton also increased. Production was from two quarries in Sussex County and one in Warren County. Agriculture was the principal market for limestone, taking almost 40 percent of the production. Uses as a filler were second in importance, followed by concrete aggregate and feedstock for manufacturing hydrated lime.

Granite production declined 5 percent to 1.2 million tons. Average value increased from $1.94 per ton to $1.96 per ton. Quarries were operated at seven locations in Morris, Hunterdon, and Sussex Counties. Small quantities were sold for riprap and filter stone; the bulk of the output was used for concrete aggregate.

Crushed miscellaneous stone (gneiss) quarried in Passaic County was used for the most part as concrete aggregate; production increased substantially. Crushed marble was produced in Warren County for terrazzo. Dimension sandstone continued to be quarried in Hunterdon County. Oystershell from Gloucester County was used in making lime and poultry grit.

Sulfur.—The value of byproduct sulfur recovered increased nearly 55 percent. The principal factor was increased prices; average unit value rose from $34.68 per long ton in 1967 to $43.92 per long ton in 1968. Shipments were up 3 percent from those of 1967. Sulfur was recovered as a byproduct of petroleum refining operations at four plants, two in Gloucester and one each in Middlesex and Union Counties. These plants recovered 50,000 long tons of sulfur valued at $2.2 million.

Vermiculite.—Exfoliated vermiculite was produced by one plant each in Essex and Mercer Counties from crude material shipped from other States or imported. Production was about the same as in 1967, but value increased 1.4 percent. Loose-fill insulation was the major use; concrete aggregate and agricultural uses also were important.

METALS

Ferroalloys.—Shieldalloy Corp., Newfield, Gloucester County, produced ferroalloys of vanadium, titanium, boron, molybdenum, columbium, and columbium-tantalum.

Titanium.—Glidden-Durkee Div. of SCM Corp. mined a titanium-bearing sand deposit at Jackson, Ocean County. Ilmenite concentrate was produced and shipped to Baltimore, Md., for conversion to titanium dioxide pigment. Both quantity and value were greater than those of 1967.

Zinc.—Manganiferous zinc ore was mined in Sussex County, crushed, and shipped directly to a smelter at Palmerton, Pa. Zinc recovered was down 1 percent in quantity from that of the previous year; average unit value remained the same. Shipments of manganiferous residuum fell off from 1967 levels.

MINERAL FUELS

Coke and Coal Chemicals.—Koppers Co., Inc. produced coke and coal chemicals at its merchant oven-coke plant at Kearney, Hudson County. Coal chemicals recovered included crude coal tar and crude light oil.

Natural Gas.—Humble Oil & Refining Co. operated 2 underground natural gas (Liquefied Petroleum Gas) storage facilities. Transcontinental Gas Pipe Line Corp. received Federal Power Commission Authority to replace its frozen earth liquid natural gas facility in Bergen County with an above-ground tank having a 290,000 barrel capacity. Excessive boiloff had been encountered in operating the frozen earth storage facility.

Peat.—Production and sales of peat moved up strongly: production increased 30 percent and sales were up 15 percent. Five producers mined six bogs, five in Sussex County and one in Warren County. Average unit value declined from $12.60 to $11.13 per ton. Output was about evenly divided between reed-sedge and humus peat. Sales were mainly in bulk form for soil conditioning. Mt. Bethel Humus Co., Inc. moved its entire Orange County, N.Y. operation to its plant at Vernon, Sussex County.

Petroleum.—Six active petroleum refineries reported, as of January 1, 1968, a total crude oil capacity of 498,000 barrels per day. Gasoline output capacity increased from 174,500 to 186,300 barrels per day. Other products recovered at the refineries included asphalt, coke, lubricants, and paraffin.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Fire clay:			
Crossman Co	P.O. Box 38 South Amboy, N.J. 08879	Pit	Middlesex.
Daniel Goff Division, Jesse S. Morie & Son, Inc.	P.O. Box 35 Mauricetown, N.J. 08329	do	Cumberland.
A. P. Green Refractories Co. Valentine Division.	Pennval Road Woodbridge, N.J. 07095	do	Middlesex.
Miscellaneous clay:			
The Alliance Clay Products Co	P.O. Box 746 Alliance, Ohio 44601	do	Camden.
Church Brick Co	P.O. Box 129 Bordentown, N.J. 08505	do	Burlington.
Glen-Gery Corporation	P.O. Box 1656 East Canton, Ohio 44730	do	Somerset.
New Jersey Shale Brick & Tile Corp.	P.O. Box 249 Somerville, N.J. 08876	do	Do.
The Rosehill Corp. t/a Oschwald Brick Works.	Cliffwood, N.J. 07721	do	Middlesex.
Sayre & Fisher Co. & Divisions.	Box 472 Sayreville, N.J. 08872	do	Do.
Gypsum, calcined:			
The Celotex Corporation	1500 North Dale Mabry Tampa, Fla. 33607	Plant	Bergen.
The Flintkote Co., Building Products Group-East.	480 Central Avenue East Rutherford, N.J. 07073	do	Camden.
Kaiser Gypsum Co., Inc	Delanco, N.J. 08075	do	Burlington.
National Gypsum Co	325 Delaware Avenue Buffalo, N.Y. 14202	do	Do.
Ilmenite:			
Glidden-Durkee, Division of SCM Corp.	P.O. Box 5, Lakehurst, N.J. 08733	Pit	Ocean.
Iron oxide pigments (manufactured):			
Columbian Carbon Co	380 Madison Avenue New York, N.Y. 10017	Plant	Mercer, Middlesex.
E. I. du Pont de Nemours & Co. Inc.	Du Pont Building Wilmington, Del. 19898	do	Essex.
Lime:			
Limestone Products Corp. of America.	122 Main Street Newton, N.J. 07860	do	Sussex.
Magnesium compounds:			
J. T. Baker Chemical Co	600 North Broad Street Phillipsburg, N.J. 08865	do	Warren.
Northwest Magnesite Co	2 Gateway Center Pittsburgh, Pa. 15222	do	Cape May.

See footnotes at end of table.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Peat:			
Horticultural Products, Inc	Sussex, N.J. 07461	Bog	Sussex.
Hyper-Humus Co	Lafayette Road Newton, N.J. 07860	do	Do.
Kelsey Humus Co., Partac Peat Co.	Kelsey Park Great Meadows, N.J. 07838	do	Warren.
Mt. Bethel Humus Co., Inc	1270 Broadway New York, N.Y. 10001	do	Sussex.
Netcong Natural Products	Lackawanna Drive Stanhope, N.J. 07874	do	Do.
Perlite (expanded):			
Coralux Perlite Corp. of New Jersey	P.O. Box 251 Metuchen, N.J. 08840	Plant	Middlesex.
Johns-Manville Products Corp	22 East 40th Street New York, N.Y. 10016	do	Somerset.
National Gypsum Co	325 Delaware Avenue Buffalo, N.Y. 14202	do	Burlington.
Zonolite Division, W. R. Grace & Co.	62 Whittemore Avenue Cambridge, Mass. 02140	do	Mercer.
Petroleum refineries:			
Chevron Oil Company	1200 State Street Perth Amboy, N.J. 08861	do	Middlesex.
Hess Oil & Chemical Company	State Street Perth Amboy, N.J. 08861	do	Do.
Humble Oil and Refining Company	Box 222 Linden, N.J. 07036	do	Union,[1] Hudson.
Mobile Oil Company [1]	P.O. Box 927 Philadelphia, Pa. 19105	do	Gloucester.
Texaco Inc	135 E. 42nd Street New York, N.Y. 10017	do	Do.
Sand and gravel:			
American Dredging Co., Sand and Gravel Division.	12 South 12th Street Philadelphia, Pa. 19107	Dredge	Burlington.
Amico Sand & Gravel Co	Norman Avenue Riverside, N.J. 08075	Pit	Do.
Braen Sand & Gravel Co	Brookside Avenue Wyckoff, N.J. 07481	do	Bergen.
Ralph Clayton & Sons	P.O. Box 220, R.D. #1 Jackson, N.J. 08527	do	Ocean.
Houdaille Const. Materials, Inc	10 Park Place Morristown, N.J. 07960	do	Morris, Ocean.
T. Landi & Sons, Inc	Ridgedale Avenue Morristown, N.J. 07960	do	Morris.
McKee Brothers, Inc	Route #17 Ramsey, N.J. 07446	do	Bergen.
Morie Division, Jesse S. Morie & Son, Inc.	P.O. Box 35 Mauricetown, N.J. 08329	do	Cumberland.
National Glass Sand Corp	P.O. Box 145 Millville, N.J. 08332	do	Do.
New Jersey Pulverizing Co	205 West 34th Street New York, N.Y. 10001	do	Ocean.
New Jersey Silica Sand Co	Millville, N.J. 08332	do	Cumberland.
Pennsylvania Glass Sand Corp	Berkely Springs, W.Va 25411	do	Do.
Pequannock Sand & Gravel Division, Union Bldg. & Const. Corp.	315 Howe Avenue Passaic, N.J. 07055	do	Morris.
George F. Pettinos, Inc	235 Bala Avenue Bala-Cynwyd, Pa. 19004	do	Camden.
Sayre & Fisher Co	P.O. Box 472 Sayreville, N.J. 08872	do	Middlesex.
Tri-Borough Sand & Stone, Inc	Haddonfield-Berlin Road Gibbsboro, N.J. 08026	do	Camden.
Warner Company	1721 Arch Street Philadelphia, Pa. 19103	Dredge	Burlington.
Whitehead Brothers Co	60 Hanover Road Florham Park, N.J. 07932	Pit	Cumberland.
Smelters (copper):			
American Metal Climax, Inc	1270 Avenue of the Americas New York, N.Y. 10020	Plant	Middlesex.
American Smelting & Refining Co	120 Broadway New York, N.Y. 10005	do	Do.
The Anaconda Company	25 Broadway New York, N.Y. 10004	do	Do.
Stone:			
Granite, crushed:			
Braen Industries, Inc	River Road Passaic, N.J. 07055	Quarry	Morris.
Glen Gardner Quarry Corp	Box 344 Glen Gardner, N.J. 08826	do	Hunterdon.

See footnotes at end of table.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—continued			
Granite, crushed—continued			
Hamburg Quarry, Inc	Route 23 Hamburg, N.J. 07419	Quarry	Sussex.
Shahmoon Industries, Inc	R.D. #1 Wharton, N.J. 07885	do	Morris.
Somerset Crushed Stone Division Anthony Ferrante & Sons, Inc.	Route 202, Mine Brook Road Bernardsville, N.J. 07924	do	Hunterdon.
Tri County Asphalt Corp	Beaufort Avenue Roseland, N.J. 07068	do	Sussex.
Limestone, crushed:			
Farber White Limestone Co	Franklin, N.J. 07416	do	Do.
Limestone Prod. Corp. of America	122 Main Street Newton, N.J. 07860	do	Do.
Oxford Stone Co	Box 56, Oxford, N.J. 07863	do	Warren.
Marble, crushed:			
The Royal Green Marble Co., Inc.	P.O. Box 101 Phillipsburg, N.J. 08865	do	Do.
Miscellaneous, crushed:			
Passaic Crushed Stone Co., Inc	Foot of Broad Pompton Lakes, N.J. 07442	do	Passaic.
Oystershell, crushed:			
Jos. Bauder & Sons [2]	Malaga Road Franklinville, N.J. 08322	Plant	Gloucester.
Sandstone, dimension:			
H. W. Lindblad	401 Belvedere Avenue Lambertville, N.J. 08530	Quarry	Hunterdon.
Traprock (basalt) crushed:			
Samuel Braen's Sons	Central Avenue Haledon, N.J. 07055	do	Passaic.
Calanan Trap Rock Corp	South Bethlehem, N.Y. 12161	do	Hudson.
Dock Watch Quarry Pit, Inc	Box 245 Martinsville, N.J. 08836	de	Somerset.
Fanwood Crushed Stone Co	141 Central Avenue Westfield, N.J. 07090	do	Do.
Great Notch Corp	U.S. Route 46 Little Falls, N.J. 07424	do	Passaic.
Houdaille Const. Materials, Inc	10 Park Place Morristown, N.J. 07960	do	Hunterdon, Passaic, Somerset, Union.
M. L. Kernan Quarry	500 Tillon Road South Orange, N.J. 07079	do	Essex.
Minnesota Mining & Manufacturing Co.	3M Center St. Paul, Minn. 55101	do	Somerset.
Orange Quarry Co	318 Eagle Rock Avenue West Orange, N.J. 07050	do	Essex.
Somerset Crushed Stone Division Anthony Ferrante & Sons, Inc.	Route 220, Mine Brook Road Bernardsville, N.J. 07924	do	Somerset.
Warren Brothers Company Sowerbutt-Standard District	Prospect Park Borough Paterson, N.J. 07502	do	Passaic.
Trap Rock Industries, Inc	Laurel Avenue Kingston, N.J. 08528	do	Hunterdon, Mercer, Somerset.
The Union Bldg. & Construction Corp.	315 Howe Avenue Passaic, N.J. 07055	do	Passaic.
Sulfur:			
The Anlin Co. of New Jersey	1200 State Street Perth Amboy, N.J. 08861	Plant	Middlesex.
Freeport Sulphur Co	161 East 42nd Street New York, N.Y. 10017	do	Gloucester.
Industrial Chemicals Division, Allied Chemical Corp.	P.O. Box 70 Morristown, N.J. 07960	do	Union.
Vermiculite (exfoliated):			
Vermiculite Industrial Corp	308 Gilligan Avenue Port Newark, N.J. 07114	do	Essex.
Zonolite Division, W. R. Grace & Co.	62 Whittemore Avenue Cambridge, Mass. 02140	do	Do.

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[1] Also byproduct elemental sulfur.
[2] Out of business June 1968.

The Mineral Industry of New Mexico

By Lorraine Burgin [1] and William C. Henkes [2]

Mineral production in New Mexico during 1968 was valued at $893.8 million, an increase of $19.7 million over that of 1967. Major contributing factors included the rapid recovery of the industry following the end of the copper strike, the increase in the value of natural gas and petroleum production, and the rise in uranium output. Fuels ranked first in value of minerals produced, $607.7 million; metals second, $193.4 million; and nonmetals, $92.7 million. Gains in fuels and metals amounted to $24.7 million and $21.4 million, respectively; the nonmetals suffered a loss of $26.4 million, chiefly because of the $27.7 million decline in the potash industry.

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[1] Geologist, Bureau of Mines, Denver, Colo.
[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1.—Mineral production in New Mexico [1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Carbon dioxide (natural) thousand cubic feet	771,516	$57	749,364	$52
Clays thousand short tons	46	74	66	89
Coal (bituminous) do	3,463	12,641	3,429	13,507
Copper (recoverable content of ores, etc.) short tons	75,008	57,345	90,769	75,968
Feldspar long tons	---------	-------	98	W
Gem stones	NA	60	NA	59
Gold (recoverable content of ores, etc.) troy ounces	5,188	182	6,630	[2] 260
Gypsum thousand short tons	155	588	146	549
Helium, grade A thousand cubic feet	71,200	2,492	39,100	1,355
Iron ore (usable) thousand long tons, gross weight	W	W	17	113
Lead (recoverable content of ores, etc.) short tons	1,827	512	1,363	360
Lime thousand short tons	17	243	27	377
Manganese concentrate (35 percent or more Mn) short tons, gross weight	W	W	6,729	W
Manganiferous ore (5 to 35 percent Mn) do	49,323	348	50,681	379
Natural gas (marketed) million cubic feet	1,067,510	138,776	1,164,182	156,000
Natural gas liquids:				
LP gases thousand 42-gallon barrels	21,647	40,003	23,802	34,989
Natural gasoline and cycle products do	8,050	20,730	8,868	23,104
Peat short tons	---------	-------	446	4
Perlite do	346,586	3,424	365,481	3,706
Petroleum (crude) thousand 42-gallon barrels	126,144	368,340	128,550	378,708
Potassium salts thousand short tons, K_2O equivalent	2,883	91,098	2,289	63,406
Pumice thousand short tons	220	639	243	527
Salt do	82	1,036	W	W
Sand and gravel do	14,672	14,336	12,262	12,396
Silver (recoverable content of ores, etc.) thousand troy ounces	157	244	225	482
Stone thousand short tons	1,391	2,403	2,226	3,527
Uranium (recoverable content U_3O_8) thousand pounds	11,202	[3] 89,615	12,282	[4] 95,144
Zinc (recoverable content of ores, etc.) short tons	21,380	5,919	18,686	5,045
Value of items that cannot be disclosed: Beryllium concentrate (1968), cement, fluorspar, mica (scrap), molybdenum, vanadium, and values indicated by symbol W	XX	23,001	XX	23,669
Total	XX	874,106	XX	893,775
Total 1957–59 constant dollars	XX	[r] 844,440	XX	[p] 863,513

[p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Based on average U.S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968, and the New York selling price for the remainder of the year.

[3] Estimated based on $8.00 per pound f.o.b. mill.

[4] Estimated based on $8.00 per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 per pound for commercial sales.

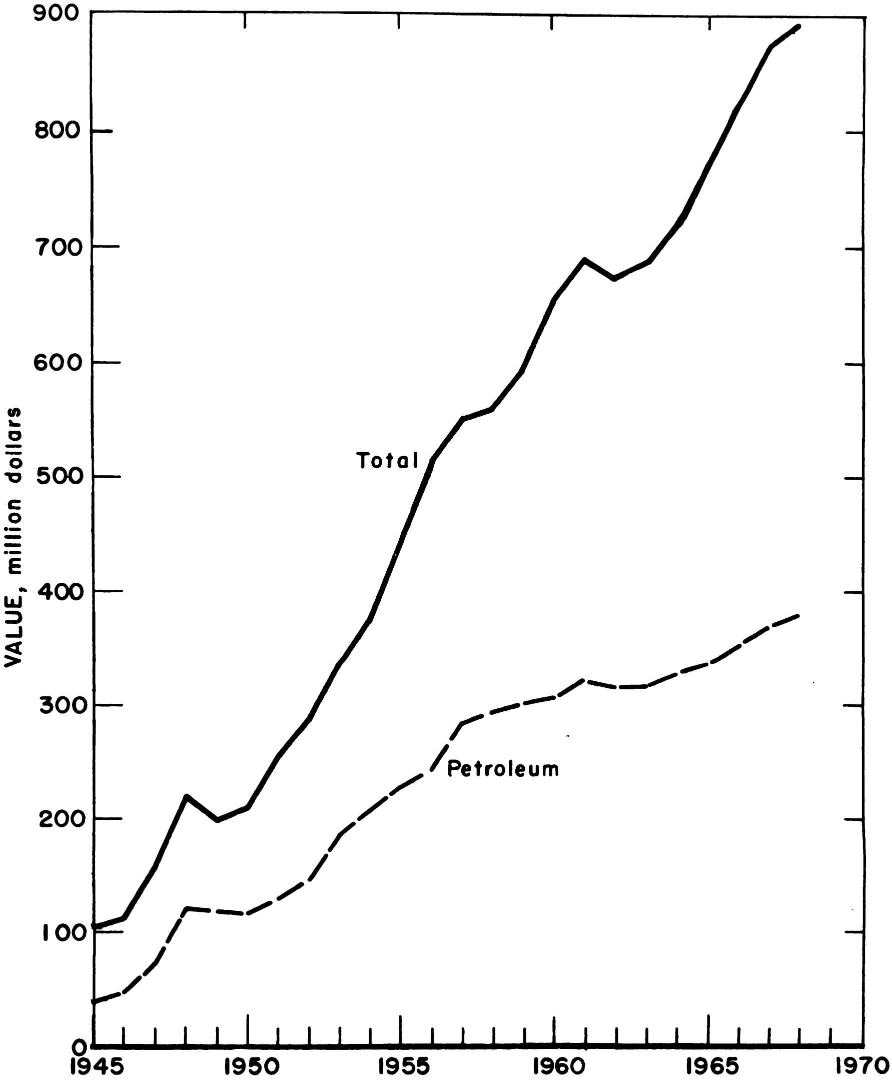

Figure 1.—Value of petroleum and total value of all mineral production in New Mexico.

Employment and Injuries.—Final data for 1967 and preliminary data for 1968, compiled by the Bureau of Mines for employment and injuries in the New Mexico mineral industries, excluding all mineral fuels except coal, are reported in table 4.

Legislation and Government Programs.—The U.S. Supreme Court, on May 1 in a 7-to-1 decision, upheld the authority of the Federal Power Commission to set natural gas prices on an area-wide basis. The ruling apparently ended the 7-year legal struggle over the fixing of prices of gas sold in

Table 2.—Value of mineral production in New Mexico, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Bernalillo	$7,390	$10,264	Cement, sand and gravel, stone, clays, pumice.
Catron	W	W	Sand and gravel, silver, gold, stone, copper, zinc.
Chaves	19,785	21,035	Petroleum, natural gas, sand and gravel, stone.
Colfax	W	W	Coal, stone, sand and gravel.
Curry	4	251	Stone.
De Baca	72	W	Sand and gravel.
Dona Ana	1,711	2,255	Sand and gravel, pumice, clays, fluorspar, stone.
Eddy	162,949	140,990	Potassium salts, petroleum, natural gas, LP gases, natural gasoline, salt, stone, sand and gravel.
Grant	64,710	82,192	Copper, zinc, molybdenum, manganiferous ore, lime, silver, gold, sand and gravel, stone, lead.
Guadalupe	W	W	Sand and gravel, copper, silver.
Harding	295	192	Sand and gravel, carbon dioxide.
Hidalgo	772	1,310	Copper, sand and gravel, silver, gold, clays, zinc, stone, lead.
Lea	337,862	364,354	Petroleum, natural gas, LP gases, natural gasoline, potassium salts, stone, sand and gravel.
Lincoln	39	130	Stone, sand and gravel, iron ore, gold, pumice, silver.
Los Alamos	36	17	Sand and gravel.
Luna	1,277	W	Sand and gravel, clays, copper, stone.
McKinley	76,051	72,634	Uranium, petroleum, coal, sand and gravel, stone, molybdenum, clays, natural gas, vanadium.
Mora	W	219	Sand and gravel.
Otero	501	766	Sand and gravel, stone.
Quay	55	50	Sand and gravel.
Rio Arriba	13,720	15,070	Natural gas, petroleum, LP gases, sand and gravel, stone, natural gasoline, pumice, feldspar.
Roosevelt	17,370	14,902	Petroleum, LP gases, natural gas, natural gasoline, sand and gravel.
Sandoval	801	976	Sand and gravel, gypsum, petroleum, pumice, peat, natural gas.
San Juan	119,552	109,478	Natural gas, petroleum, coal, LP gases, helium, natural gasoline, sand and gravel, vanadium, uranium, pumice, stone.
San Miguel	W	72	Sand and gravel, stone.
Santa Fe	723	502	Sand and gravel, gypsum, stone, pumice.
Sierra	1,365	711	Sand and gravel, stone, silver, copper, gypsum, lead.
Socorro	1,552	1,552	Sand and gravel, zinc, lead, manganese concentrate, iron ore, silver, stone, copper, gold.
Taos	19,420	17,821	Molybdenum, perlite, sand and gravel, mica, beryllium concentrate, clays, stone.
Torrance	59	W	Sand and gravel, stone.
Union	W	W	Pumice, sand and gravel.
Valencia	W	W	Uranium, sand and gravel, perlite, stone.
Undistributed [1]	[r]26,035	36,030	
Total [2]	874,106	893,775	

[r] Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

interstate commerce. The Permian basin test case thus established the following ceiling prices in New Mexico: New gas-well gas, 15.5 cents per thousand cubic feet; all other gas, 13.5 cents per thousand cubic feet; minimum price, 9 cents per thousand cubic feet.

In a review of its 10 years of operations the State Oil and Gas Accounting Commission reported collection of $420,107,409 from the oil and gas industry. Collection costs averaged 45.5 cents per $100 of revenue collected. The Commission receives six separate taxes paid in a lump sum by the operators. From September 1959 through December 1968 the following sums were collected: School tax, $81,664,121; severance tax, $91,204,861; conservation tax, $5,106,562; ad valorem tax, $49,991,383; oil and gas manufacturers' tax, $5,089,332; and State royalty, $187,051,150. For 1968 the revenues were school tax, $12,165,701; severance tax, $11,927,218; conservation tax, $667,807; ad valorem tax, $6,805,748; oil and gas manufacturers' tax, $1,055,182, and State royalty, $26,339,817; total, $58,961,473.[3]

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[3] New Mexico Oil and Gas Accounting Commission. Oil and Gas Accounting Report for Period January 1968 through December 1968. Mar. 7, 1969.

Table 3.—Indicators of New Mexico business activity

	1967[r]	1968[p]	Change (percent)
Employment and labor force, annual average:			
Total labor force ... thousands	318.8	320.6	+.6
Total employment ... do	313.5	315.5	+.6
Total unemployment ... do	5.3	5.1	—3.8
Total agricultural employment ... do	12.6	12.5	—.8
Total nonagricultural employment ... do	300.9	308.0	+.7
Mining ... do	15.9	15.8	—.6
Construction ... do	16.4	17.3	+5.5
Manufacturing ... do	18.0	17.9	—.6
Trade ... do	57.0	57.2	+.4
Government ... do	98.2	99.3	+1.1
Services and miscellaneous ... do	64.1	64.3	+.3
All other ... do	31.3	31.2	—.3
Payroll data, wages paid: Total ... millions	$1,681.7	$1,762.0	+4.8
Agriculture ... do	$21.1	$21.6	+2.4
Mining ... do	$119.7	$122.7	+2.5
Construction ... do	$103.5	$116.4	+12.5
Manufacturing ... do	$108.6	$110.6	+1.8
Trade ... do	$241.0	$272.6	+13.1
Government ... do	$590.6	$599.9	+1.6
Services and miscellaneous ... do	$302.9	$314.2	+3.7
All other ... do	$194.8	$204.0	+5.0
Personal income:			
Total ... do	$2,485.5	$2,636.2	+6.1
Per capita	$2,419.0	$2,584.0	+6.8
Construction activity:			
Cement shipments to and within the State thousand 376-pound barrels	2,407.5	2,909.7	+20.9
Residential construction ... millions	$83.4	$96.1	+15.2
Nonresidential construction ... do	$91.0	$71.8	—21.1
Nonbuilding construction ... do	$110.8	$119.6	+7.9
Highway construction contracts awarded ... do	$45.4	$36.7	—19.2
Business receipts ... do	$3,293.8	$3,652.3	+10.9
Farm marketing receipts ... do	$317.4	$338.6	+6.7
Mineral production ... do	$874.1	$893.8	+2.3
Electric power produced[1] ... million kilowatt hours	9,353.2	9,017.7	—3.6
Natural gas produced ... billion cubic feet	1,051.9	1,148.0	+9.1

[p] Preliminary. [r] Revised.

[1] Includes Four Corners Plant production of 4,205.6 million kilowatt hours in 1967 and 4,967.4 in 1968, most of which is used out of State.

Sources: Bureau of Business Research, The University of New Mexico, Albuquerque, N. Mex. 87106; Engineering News-Record, v. 182, No. 14, Apr. 3, 1969, pp. 52–53; U.S. Bureau of Mines.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	281	241	68	539	-------	22	40.84	2,083
Metal	3,460	246	850	6,804	3	276	41.00	4,315
Nonmetal	2,745	330	906	7,246	6	209	29.67	5,685
Sand and gravel	1,181	167	197	1,617	1	32	20.41	7,824
Stone	255	198	51	409	-------	8	19.56	259
Total[1]	7,922	261	2,071	16,615	10	547	33.52	5,082
1968:[p]								
Coal	275	245	67	529	-------	21	39.66	2,023
Metal	4,160	258	1,098	8,802	4	257	29.65	3,601
Nonmetal	2,230	306	683	5,504	3	187	34.52	3,926
Sand and gravel	960	167	160	1,320	-------	38	28.79	2,098
Stone	255	218	55	444	-------	5	11.26	261
Total[1]	7,875	259	2,064	16,600	7	508	31.02	3,449

[p] Preliminary.

[1] Data may not add to totals shown because of independent rounding.

The results of pertinent studies by State and Federal agencies were published.[4]

Of the 998.4 miles of designated interstate highway in New Mexico, 683.7 miles were open to traffic at yearend; construction was underway on 277.2 miles; only 37.5 miles had no work in progress.[5] Planned highway contracts for 1969 totaled about $55.5 million, up 51 percent from 1968. Contracts awarded in 1968 totaled $36.6 million for highway construction; $18.2 million was for the Interstate system.[6] The increase in value of contracts awarded should increase the quantity of cement, sand and gravel, scoria, and stone used in highway construction.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The value of mineral fuels production increased $24.7 million, or 4 percent. The total value of $607.7 million comprised 68 percent of the value of State mineral production. Increases in every category of mineral fuels except carbon dioxide, helium, and natural gas liquids resulted in a net increase in total mineral production value.

Carbon Black.—The two carbon black plants in the State—Continental Carbon Co. and Ashland Chemical Co. (United Carbon Co. until October 1968)—produced 44.2 million pounds of carbon black from 13.9 billion cubic feet of natural gas. Output decreased 12 percent from the 50.1 million pounds produced in 1967.

Carbon Dioxide.—Output of carbon dioxide decreased by 22.2 million cubic feet (2.9 percent); value was down 8.8 percent. Through a merger of two of the three operators in Harding County only the S.E.C. Corp. and Schwartz Carbonic Co. continued as producers.

Coal.—Output of coal decreased slightly to 3,429,102 short tons, whereas value of production increased 7 percent to $13,506,864. Six mines were operated in the State—two each in Colfax, McKinley, and San Juan Counties.

The Navajo strip mine of Utah Construction & Mining Co. is located near Fruitland, 12 miles west of Farmington, San Juan County, on land leased from the Navajo Indian Tribe. According to the company's annual report the mine yielded 2.3 million tons, compared with 2.45 million tons in 1967. Adjacent to the mine Arizona Public Service Co. operated three generating units totaling 575,000 kilowatt capacity; this power output would normally require 2.5 million tons of coal per year to be supplied from the Navajo mine under a 35-year contract. In another 35-year contract coal from the mine is to be delivered to two new generating units adjacent to Arizona Public Service Co. Owned jointly by Southern California Edison Co., Arizona Public Service Co., Salt River Project, Public Service of New Mexico, Tucson Gas and Electric Co., and El Paso Electric Co., the additional generating units, 755,000-kilowatt capacity each, were under construction during the year. With requirements of both contracts, Navajo mine deliveries are expected to total 8.5 million tons by mid-1970.

In anticipation of further expansion up to an additional 2.4 million kilowatts of generating capacity, the mining company acquired the right to purchase 44,000 acre-feet of water per year from the Navajo Reservoir beginning in 1972. This planned expansion would increase the consumption of coal by 9.7 million tons per year—doubling annual coal requirements to approximately 18 million tons.

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[4] Bingler, Edward C. Geology and Mineral Resources of Rio Arriba County, New Mexico. New Mexico Bur. Mines and Miner. Res. Bull. 91, 1968, 158 pp.
Doney, Hugh H. Geology of the Cebolla Quadrangle, Rio Arriba County, New Mexico. New Mexico Bur. Mines and Miner. Res. Bull. 92, 1968, 114 pp.
Gard, Leonard M., Jr. Geologic Studies Project Gnome, Eddy County, N. Mex. U.S. Geol. Survey Prof. Paper 589, 1968, 33 pp.
Granger, Harry C. Localization and Control of Uranium Deposits in the Southern San Juan Basin Mineral Belt, New Mexico—An Hypothesis. U.S. Geol. Survey Prof. Paper 600–B, 1968, pp. B60–B70.
Griffitts, Wallace R., and Henry V. Alminas. Geochemical Evidence for Possible Concealed Mineral Deposits Near the Monticello Box, Northern Sierra Cuchillo, Socorro County, N. Mex. U.S. Geol. Survey Circ. 600, 1968, 13 pp.
Jones, Charles L., and Beth M. Madsen. Evaporite Geology of Fifth Ore Zone, Carlsbad District, Southeastern N. Mex. U.S. Geol. Survey Bull. 1252–B, 1968, pp. B1–B21.
Misaqi, F. Leo. Geochemical Anomalies in the Philmont Ranch Region, New Mexico. New Mexico Bur. Mines and Miner. Res. Circ. 92, 1968, 12 pp.
Sheffer, Herman W., and Louis H. Goldsmith. Report on Tantalum Project, Rociada, N. Mex. BuMines Open-File Report, 1968, 35 pp.
Summers, W. Kelly. Geothermics—New Mexico's Untapped Resource. New Mexico Business, v. 21, No. 8, August 1968, pp. 1–9.

[5] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program, Dec. 1, 1968. Press Release FHWA–295, Feb. 24, 1969.

[6] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1969 and Budgets for Maintenance. V. 182, No. 14, Apr. 3, 1969, pp. 52–58.

A second dragline with a 300-foot boom and 65-yard bucket was placed in operation at the Navajo mine; construction of a third dragline is scheduled for completion in 1969.

Kaiser Steel Corp. shipped from its underground York Canyon operation near Raton, Colfax County, to its Fontana, Calif., steel plant. The company used continuous mining machines in producing coking coal from this operation. The Pittsburg & Midway Coal Mining Co., a subsidiary of Gulf Oil Corp., continued output from the McKinley strip mine west of Gallup, McKinley County. Other producers included the Sundance strip mine, Sundance Coal Co., in McKinley County; the Hogback 13 mine, Hogback Coal Co., in San Juan County; and the Franks 1, leased by Julius Seidel, in Colfax County.

Helium.[7]—The only helium extraction plant in New Mexico is located at Shiprock. The Bureau of Mines owned and operated the plant until August 1, 1968, when the plant was transferred to the Bureau of Indian Affairs and subsequently to the Navajo Indian Tribe. Air Reduction Co. operates the plant for the Tribe.

Under Bureau ownership, the plant produced 36.9 million cubic feet of grade A helium in 1968, valued at $1.3 million at the Bureau's sales price of $35 per 1,000 cubic feet. Under ownership of the Navajo Tribe, the plant produced an estimated 2.2 million cubic feet of grade A helium. At $25 per 1,000 cubic feet on the private market, this output was worth $55,000.

The total volume of helium extracted from natural gas at the Shiprock plant in 1968 was 39.1 million cubic feet, 32.1 million cubic feet less than the 71.2 million cubic feet extracted in 1967. Shipment by the Bureau was by railway tankcars and highway semitrailers from a shipping terminal at Gallup. The terminal is no longer in use, and shipments from the plant are made in semitrailers. The plant has no facilities for liquefaction of helium.

Natural Gas.—Marketed natural gas was 9 percent higher in quantity and 12 percent in value than in 1967. San Juan County, the largest producer, had an increase in output of 11.3 percent. Two counties with very small production—Sandoval and Chaves—registered gains of 26 and 89 percent; but Eddy County, with production of 125.3 billion cubic feet, had a 23 percent increase.

According to the State Oil Conservation Commission, 8,754 gas wells were producing from 183 gas pools at yearend. Casinghead gas, of course, was produced from many of the oilfields.

Estimates of natural gas reserves made by American Petroleum Institute (API) and American Gas Association, Inc. (AGA), increased slightly to 15.1 trillion cubic feet, a gain of 50.7 billion cubic feet. Additions from new fields and pools were 59.5 billion cubic feet and from extensions and revisions 1.1 trillion.[8]

The State received $12.7 million in taxes and royalty from gas production; royalties amounted to $3.7 million.[9] The figures do not include bonuses and rentals received for leases on State lands nor the State's share (37.5 percent) of royalties paid on production from public domain.

Of the 11 gas discoveries, four were in Eddy County, three each in Lea and San Juan Counties, and one in Chaves County. On the basis of initial potential Eddy County's Rock Tank field discovery was the most important. The discovery well, Monsanto Co., Rock Tank Unit No. 1, sec 7, T 23 S, R 25 E, was completed in two zones of the Morrow Formation (Pennsylvanian) for a combined calculated open-flow gage of 51.6 million cubic feet of gas per day; perforations were from 9,965 to 9,978 feet (6.7 million cubic feet) and from 10,290 to 10,298 feet (44.9 million cubic feet).

American Trading and Production Corp., N.M. State "26" No. 1, sec 26, T 20 S, R 35 E, Lea County, was completed to open the Southeast Lea field as a dual discovery in the Wolfcamp Formation (Permian) and in the Devonian. From Wolfcamp perforations from 11,400 to 11,470, the well had a calculated open-flow gage of 15.6 million cubic feet of gas; from the Devonian at 14,560 to 14,644 feet (open hole) it flowed 210 barrels of 53° API oil per day.

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[7] Prepared by Office of the Assistant Director—Helium, Washington, D.C.

[8] American Gas Association, Inc., American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada as of Dec. 31, 1968. V. 23, May 1969, p. 120.

[9] Work cited in footnote 8.

At midyear Phillips Petroleum Co. discovered the Hat Mesa field in Lea County. The discovery well, Hat Mesa Unit No. 1, sec 11, T 21 S, R 32 E, was completed for a calculated open-flow gage of 7.5 million cubic feet of gas per day from the Morrow Formation from perforations at 13,656 to 14,100 feet.

At yearend several gas pipeline projects were under construction. Natural Gas Pipeline Company of America was building a 15-mile, 6-inch line in Eddy County. El Paso Natural Gas Co. began a $118 million project to supply daily an additional 310 million cubic feet of gas to consumers in California, Arizona, New Mexico, Nevada, and Texas; southern California will receive 257 million cubic feet; the rest will go to other markets. Construction will include approximately 670 miles of mainline, gathering, and field pipelines, two compressor stations, and improvements to existing facilities. In New Mexico, 123 miles of 30-inch pipeline will be built; power will be increased by 1,500 horsepower each at the Afton compressor station, near Las Cruces, and at the Florida station, near Deming; and 10,300 horsepower will be added to the Lordsburg compressor station.

Preliminary postshot studies of the Project Gasbuggy gas well were made during the year. The project—the first attempt to increase gas flow from a low-permeability formation by nuclear explosion—was conducted by the U.S. Atomic Energy Commission (AEC), Bureau of Mines, and El Paso Natural Gas Co. The 26-kiloton explosive was detonated December 10, 1967, about 55 miles east of Farmington. The preliminary studies indicate the rubble "chimney" created by the blast is about as predicted; the surrounding fracture zone, however, may extend farther than anticipated. Presence of radioactive krypton-85 and tritium in the gas has been detected but apparently presents no health hazard.

Natural Gas Liquids.—Output of natural gas liquids increased 10 percent. The 40 extraction plants processed a total of 1.04 trillion cubic feet of natural gas of which 928.1 billion were turned to pipelines and 3.4 billion were reinjected into reservoirs.

The API and AGA, in their annual estimate of reserves as of January 1, 1969, credited the State with proved reserves of 604.2 million barrels of natural gas liquids, an increase of 48.5 million barrels, or 8.7 percent. The increase was credited to southeastern New Mexico where net addition to reserves was 61.2 million barrels, bringing that area to a total of 275.7 million barrels. Just over half of the State's reserves, 54 percent, were in the San Juan basin.[10]

Pan American Petroleum Corp. in January completed expansion of its Empire Abo gasoline plant. The 4-million-cubic-foot-per-day expansion brought the daily capacity of the refrigerated-absorption unit to 35,000 gallons of propane, 20,000 gallons of butane, and 17,000 gallons of natural gasoline.

An expansion also was made at the Indian Basin plant of Marathon Oil Co.; daily productive capacity was increased to 49,900 gallons of propane, 42,800 gallons of butane, and 49,400 gallons of natural gasoline.

Peat.—For the first time New Mexico reported the production of peat. From a deposit of humus near San Ysidro, Sandoval County, T. L. Fox mined 446 tons for use as an additive to a commercial fertilizer.

Petroleum.—For the fifth successive year crude oil production in the State attained a new high; the statewide increase was 1.9 percent. The 3.1-million-barrel increase in southeastern New Mexico more than compensated for the 669,000-barrel decline in the San Juan basin. McKinley County was the only northwestern county to record an increase; Hospah field accounted for most of the additional output. Lea County continued as the leading source with 69 percent of the State production; its increase in output, 4.7 million barrels, was by far the largest in the State.

The State Oil Conservation Commission reported that, at yearend, 16,903 wells were producing oil from 673 reservoirs; the numbers of both wells and reservoirs increased during the year. The Commission also reported that 2,457 injection wells were operating in secondary-recovery or pressure-maintenance projects. Ninety-one percent of the production of the produc-

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[10] Page 123 of work cited in footnote 8.

Table 5.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1967	1968	Principal fields (producing more than 1 million barrels) in 1968, in order of production
Chaves	6,402	6,751	Cato, Caprock.
Eddy	18,797	17,916	Empire, Grayburg, Loco Hills.
Lea	84,613	89,282	Vacuum, Bagley, Hobbs, Monument, Vada, Inbe, Justis, Maljamar, Denton, Crossroads, Langlie.
McKinley	312	482	
Rio Arriba	1,343	1,298	
Roosevelt	5,258	4,196	Chaveroo.
Sandoval	4	4	
San Juan	9,415	8,621	Horseshoe, Tocito.
Total	126,144	128,550	

Source: New Mexico Oil & Gas Engineering Committee. Annual Report 1968. V. 1–2, 726 pp.

Table 6.—Oil and gas well drilling in 1968, by counties

County	Oil	Gas	Dry	Total	Footage
EXPLORATORY COMPLETIONS					
Catron	-----	-----	1	1	7,900
Chaves	4	1	29	34	168,888
Colfax	-----	-----	1	1	5,204
Curry	-----	-----	2	2	6,613
Eddy	4	4	11	19	139,470
Guadalupe	-----	-----	3	3	3,328
Harding	-----	-----	2	2	4,321
Lea	17	3	38	58	525,913
McKinley	-----	-----	10	10	17,746
Rio Arriba	-----	-----	1	1	2,517
Roosevelt	3	-----	9	12	55,317
Sandoval	-----	-----	3	3	4,680
San Juan	2	3	18	23	74,180
San Miguel	-----	-----	2	2	7,774
Torrance	-----	-----	1	1	2,858
Union	-----	-----	1	1	4,190
Total	30	11	132	173	1,030,899
DEVELOPMENT COMPLETIONS					
Chaves	53	3	15	71	259,470
De Baca	-----	-----	1	1	2,030
Eddy	36	6	10	52	176,236
Lea	309	5	60	374	3,160,893
McKinley	10	-----	3	13	16,869
Rio Arriba	1	78	9	88	581,587
Roosevelt	56	1	4	61	276,637
Sandoval	-----	3	5	8	16,098
San Juan	31	94	30	155	550,243
Total	496	190	137	823	5,040,063
Total all drilling	526	201	269	996	6,070,962

Sources: Committee on Statistics of Drilling, American Association of Petroleum Geologists (Eastern New Mexico); Petroleum Information Corp., 1968 Résumé, Oil and Gas Operations in the Rocky Mountain Region, pp. C–1–4, C–1–5 (Western New Mexico).

ing wells and of the reservoirs was from the Permian basin.

The State received $45.2 million in taxes and royalty from oil production in 1968; of this total, royalties amounted to $22.7 million.

Annual reserve estimates by API and AGA[11] lowered the State's total oil reserves by 61.1 million barrels to 864.7 million. New fields and new pools added 2.1 million barrels, and extensions and revisions added 57.6 million; these additions were insufficient to offset the depletion of reserves by production. Additional reserves available by fluid injection were estimated to be 213.2 million barrels.

Drilling activity continued to decline. Overall drilling was down 9.8 percent from the 1,104 wells drilled in 1967. Development drilling declined 10.9 percent and

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[11] Page 26 of work cited in footnote 8.

Table 7.—Principal oil and gas discoveries in 1968

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks
			Section	Township	Range				Barrels of oil per day	Thousand cubic feet of gas per day		
Chaves County: Wildcat.	No. 1–33 Pubco-Federal.	Pennzoil United, Inc.	33	8 S	31 E	Pennsylvanian	8,508– 8,516	10,652	------	2,055	Oct. 15	Flowing.
Eddy County:												
Mesquite	No. 1–A Federal	do	8	18 S	31 E	Strawn	11,001–11,002	13,016	304	------	Feb. 27	Do.
Wildcat	No. 1 Levers-Federal.	Continental Oil Co.	2	21 S	25 E	Cisco Canyon Reef.	8,088– 8,104	10,362	------	4,400	Dec. 19	Do.
Rock Tank	No. 1 Rock Tank Unit.	Monsanto Co.	7	23 S	25 E	Upper Morrow.	9,965– 9,978	11,026	------	6,698	Feb. 2	Do.
						Lower Morrow.	10,290–10,298	------	------	44,916		
Wildcat	No. 1–B Trigg-Federal.	Pan American Petroleum Corp.	34	17 S	27 E	Morrow	9,626– 9,748	10,610	------	7,000	Oct. 30	Do.
Lea County:												
Brunson, East	No. 5 Max Gutman	Ernest A. Hanson	19	22 S	38 E	Granite Wash	7,356– 7,391	7,447	[1] 280	------	Apr. 23	Flowing. New pay.
Cerca	No. 1–D State Communitized.	Superior Oil Co.	4	14 S	34 E	Pennsylvanian "A."	10,402–10,408	11,031	380	------	May 27	Flowing.
Crossroads, South.	No. 1–22 Santa Fe	J. M. Huber Corp.	22	10 S	36 E	Strawn	10,582–10,584	12,260	326	------	May 12	Flowing. New pay.
Denton, East	No. 1 Mitchell	Robert G. Brown-Aikman Bros.	5	15 S	38 E	Wolfcamp	9,560– 9,568	13,112	220	------	July 22	Pumping.
Dogie Draw	No. 1 Gulf-Federal	Southland Royalty Co.	20	25 S	35 E	Lower Wolfcamp.	13,466–14,379	20,066	213	------	June 18	Flowing.
Hat Mesa	No. 1 Hat Mesa Unit.	Phillips Petroleum Co.	11	21 S	32 E	Morrow	13,656–14,100	15,721	------	7,514	June 28	Do.
King	No. 1 McCrory	An-Son Corp.	1	14 S	37 E	Canyon	11,053–11,067	12,900	272	------	Dec. 14	Flowing. New pay.
King, West	No. 1 Harmon	Southwest Production Co.	5	14 S	37 E	do	11,399–11,681	11,810	240	------	Mar. 6	Flowing.
Lea, Southeast	No. 1 N. M. State "26."	American Trading and Production Corp.	26	20 S	35 E	Wolfcamp	11,400–11,470	14,644	------	15,557	Apr. 2	Do.
						Devonian	14,560–14,644	------	210			
Lovington, West	No. 1–33–K State	Jake L. Hamon	30	16 S	36 E	do	13,056–13,058	13,130	205	------	Sept. 23	Do.
Wildcat	No. 16 W. D. Grimes-NCT–A.	Gulf Oil Corp.	32	18 S	38 E	Glorrieta	5,389– 5,391	7,050	281	------	Aug. 10	Do.
	No. 1 Huber-State	Meadco Production, Ltd.	9	12 S	33 E	Canyon	9,478– 9,665	10,300	236	------	July 11	Do.
	No. 1 Phillips-State.	Medco Production, Ltd.-Chambers & Kennedy.	22	11 S	36 E	Wolfcamp	9,918– 9,931	10,584	356	------	Nov. 8	Pumping.

See footnotes at end of table.

Table 7.—Principal oil and gas discoveries in 1968—Continued

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks
			Section	Township	Range				Barrels of oil per day	Thousand cubic feet of gas per day		
Lea County—Continued												
Wildcat—Continued	No. 1-8 Gallager-State.	Pennzoil United, Inc.	8	17 S	34 E	Cisco	11,712–11,725	11,825	434	------	Nov. 12	Flowing.
	No. 1 Midway-State.	Union Oil Company of Calif.	12	17 S	36 E	Devonian	11,476–11,520	11,671	538	------	Dec. 23	Do.
Vacuum	No. 126 Bridges-State.	Mobil Oil Corp	11	17 S	34 E	Morrow	11,855–11,932	12,046	219	------	June 25	Flowing. New pay.
Roosevelt County: Prarie, South.	No. 1 Lone Star-Federal.	J. M. Huber Corp	20	8 S	36 E	Devonian	12,871–12,947	13,000	288	------	Sept. 5	Flowing.
San Juan County: Wildcat	No. 1 Navajo J	Kerr-McGee Corp	23	23 N	20 W	McCracken	3,982– 4,008 4,018– 4,028	4,300	160	------	NA	Pumping.
	No. 1 Navajo Tribal-AD.	Pan American Petroleum Corp.	13	30 N	21 W	Cutler	1,768– 1,778	5,106	------	2,544	NA	Flowing.

[1] Completed for 280 barrels of oil on an 8-hour test.

Sources: Rinehart Oil News Co., Oil & Gas Yearbook, 1969; Petroleum Information Corp., 1968 Résumé, Oil and Gas Operations in the Rocky Mountain Region.

wildcat drilling 3.9 percent. Total footage drilled, however, increased by 91,000 feet; average well depth was 6,095 feet, compared with 5,417 feet for the previous year.

Success ratio for development drilling was 83.4 percent and for wildcat drilling 23.7 percent, somewhat better than that of 1967. As was expected Lea County led in both wildcat and development drilling; it had 45.9 percent of the discoveries.

Of the 30 oil discoveries, the highest initial potential was reported for Union Oil Company of California, Midway-State No. 1, sec 12, T 17 S, R 36 E, Lea County. The well, completed in late December, had an initial daily flow gage of 538 barrels of 49.6° API oil from Devonian perforations from 11,476 to 11,520 feet. The field was unnamed at yearend.

Pennzoil United, Inc., also had an unnamed discovery at yearend. The discovery well, Gallager-State No. 1–8, sec 8, T 17 S, R 34 E, Lea County, was completed for an initial flow gage of 434 barrels of 41° API oil per day from the Cisco Formation (Pennsylvanian) from the interval 11,712 to 11,725 feet.

The Cerca field, Lea County, was discovered when the Superior Oil Co., State Communitized No. 1–D, sec 4, T 14 S, R 34 E, was completed flowing 380 barrels of 43° API oil per day from perforations from 10,402 to 10,408 feet in the Pennsylvanian.

The State's six refineries had runs to stills of 13.4 million barrels; all of it was from New Mexico production. Out-of-State shipments totaled 115.1 million barrels. Principal destinations and quantities of out-of-State shipments were Texas, 40.7 million barrels; Illinois, 27.7 million; and Indiana, 16.7 million.

Mercury Chemical & Petroleum, Inc., announced early in the year that its proposed $20 million methanol plant would be built in Artesia rather than Los Lunas; availability of natural gas at a lower rate was given as the reason for the site selection. The plant, to be completed in 1969, has a designed annual capacity of 264,000 tons of methanol and 100 million pounds of formaldehyde.

METALS

Metal production was valued at $193.4 million, a $21.4 million gain over that of 1967. The 12-percent increase was due principally to resumption of operations after the copper strike and an increase in the price of copper, the value of copper production climbing $18.6 million. The next most substantial increase was the $5.5 million gain in the uranium industry. Although the settlement of the copper strike contributed to the rise in gold and silver production, the price of $2.1446 per troy ounce (average) for silver resulted in reopening several mines, including a major silver-producing mine. Both factors brought the value of silver production to $482,000, the highest dollar level since 1948. Decline in production of molybdenum was mainly attributed to some mining and milling problems encountered at a major operation. Lead and zinc decreased in tonnage and value. The $176,000 loss in value of vanadium output was due principally to the closing of a uranium mill at Shiprock, which was equipped with a vanadium recovery circuit. Manganese concentrate, iron ore, and beryllium concentrate all showed gains in output and value.

Beryllium.—Pennsylvania Glass Sand Corp., a subsidiary of International Telephone & Telegraph Corp., shipped a small amount of beryllium from the Harding mine in the Picuris mining district, Taos County.

Copper.—Copper production reached 90,769 tons of metal valued at $76 million, representing a 21 percent increase in production and a 32-percent gain in value. The end of the copper strike was partly the cause for the $18.6 million increase in value of copper production; also, the price of copper rose from an average 38.226 cents per pound in 1967 to an average 41.847 cents per pound during the 9-month period in 1968 after the end of the strike.

Operations were resumed in March at the Chino open-pit copper mine of Chino Mines Division, Kennecott Copper Corp., Santa Rita, Grant County, following settlement of the strike that began July 15, 1967, and lasted 259 days, the longest strike in the history of the mine. Losses to the Silver City area, Grant County, were reported by the Denver Post, April 2, 1968, as more than $18 million: about $73,000 per day for wages, taxes, and money for supplies and services normally spent by Kennecott.

During the year Chino Mines, which employs nearly 1,500 people, achieved a new safety record. The mine plant, representing one-half of the total work force, had no lost-time accidents. Frequency rate for the entire division, including the reduction plant at Hurley, was 0.87, with only two lost-time injuries in about 2.3 million man-hours. U.S. industry averaged 7.22 disabling accidents per million man-hours worked.

The results of pilot tests and studies conducted at Chino Mines at Hurley revealed that copper losses in the mill-flotation circuit were largely due to slime interference. In tests cleaner tailing retreatment improved copper and molybdenite recovery. The mill was modified in June 1968 to include a tailing-sand flotation retreat circuit. Copper recovery was expected to increase 5 percent or 20,000 pounds per day, and molybdenite 500 pounds per day.[12]

The new open-pit copper mine and mill at Tyrone, 10 miles southwest of Silver City, Grant County, will be the third largest mine of Phelps Dodge Corp. Construction of the new complex commenced in 1967; production from the mill was expected by mid-1969. The annual report of the company showed investment at this project in 1968 was about $38.5 million; the total cost of the project was estimated at $110 million, including preoperating mine-development expense of $6.5 million (net of income tax benefit). Planned production was 55,000 tons per year of contained copper metal. Stripping operations were continued with a total of 63 million tons of waste expected to be removed by mid-1969. Equipment engaged in the waste-removal operation included five 10-cubic-yard electric shovels, eighteen 85-ton trucks, and three rotary drills.

Completed were service buildings, equipment repair shops, machine shop, boiler shop, electric shop, safety building, warehouse and storage building, and an administration building. The shopping center and more than 180 homes at a townsite 7 miles from the mine-mill area were finished.

Under the direction of Leeds, Hill & Jewett, Inc., a San Francisco engineering firm, a water-development project was begun to bring water 23 miles from the Gila River to the mine-mill site at Tyrone, a vertical lift of about 1,600 feet. Construction will involve a diversion, a holding reservoir, a primary pumping plant, a booster pumping plant, and pipeline. The pumping plants and pipeline were designed

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[12] Rousseau, Edwin S. Tailing Sand Flotation Pilot Plant at Chino. Min. Cong. J., v. 54, No. 9, September 1968, pp. 52–56.

Table 8.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals[1]

Year	Mines producing		Lode material sold or treated [2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1964	41	1	7,882	6,110	$214	242	$313
1965	34	2	9,006	9,641	337	288	372
1966	36	---------	9,438	9,295	325	243	314
1967	24	2	4,807	5,188	182	157	244
1968	24	2	7,011	6,630	260	225	482
1848–1968	NA	NA	NA	2,287,878	53,438	74,336	59,736

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1964	86,104	$56,140	1,626	$426	29,833	$8,115	$65,208
1965	98,658	69,850	3,387	1,057	36,460	10,646	82,262
1966	108,614	78,571	1,596	482	29,296	8,496	88,189
1967	75,008	57,345	1,827	512	21,380	5,919	64,202
1968	90,769	75,968	1,363	360	18,686	5,045	82,116
1848–1968	2,964,713	1,393,165	347,229	50,080	1,402,842	278,784	1,835,204

NA Not available.

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore, old tailings, old slag, or copper precipitates shipped to smelters during the calendar year indicated.

[2] Does not include gravel washed or tonnage of precipitates shipped.

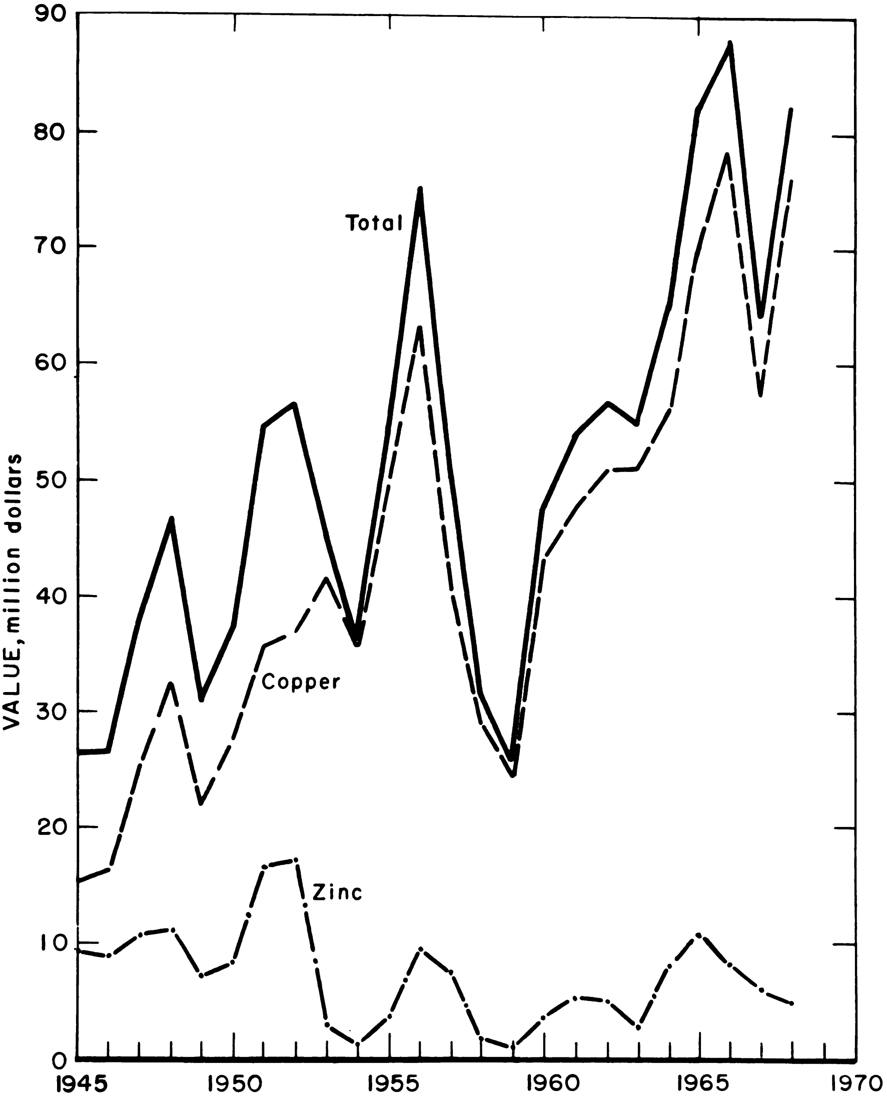

Figure 2.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico. The value of gold, silver, and lead produced annually has been relatively small.

Table 9.—Mine production of gold, silver, copper, lead, and zinc in 1968, by counties, in terms of recoverable metals

County	Mines producing [1]		Lode material sold or treated [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
Catron	1	---------	[3] 26,344	[3] 963	[3] $37,807	[3] 55,592	[3] $119,223
Grant	12	1	6,943,962	4,692	184,208	143,921	308,653
Guadalupe	1	---------	(3)	(3)	(3)	(3)	(3)
Hidalgo	3	---------	40,856	945	37,101	24,343	52,206
Lincoln	---------	1	---------	30	1,178	35	75
Luna	1	---------	13	---------	---------	---------	---------
Sierra	3	---------	246	---------	---------	975	2,091
Socorro	3	---------	(3)	(3)	(3)	(3)	(3)
Total:							
1968	24	2	7,011,421	6,630	260,294	224,866	482,248
1967	24	2	[r] 4,806,914	5,188	181,580	157,495	244,117

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Catron	[3] 9	[3] $7,825	[3] 1,130	[3] $298,499	[3] 1,667	[3] $450,049	[3] $913,403
Grant	89,658	75,037,948	231	61,092	17,015	4,594,198	80,186,099
Gaudalupe	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Hidalgo	1,101	921,178	2	515	4	972	1,011,972
Lincoln	---------	---------	---------	---------	---------	---------	1,253
Luna	(4)	335	---------	---------	---------	---------	335
Sierra	1	921	(4)	53	---------	---------	3,065
Socorro	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Total:							
1968	90,769	75,968,207	1,363	360,159	18,686	5,045,219	82,116,127
1967	75,008	57,345,116	1,827	511,560	21,380	5,919,266	64,201,639

[r] Revised

[1] Operations at plants leaching runoff water and old mill and miscellaneous cleanups not counted as producing mines.

[2] Does not include tonnage of precipitates shipped or gravel washed.

[3] Production of Catron, Guadalupe, and Socorro Counties combined to avoid disclosing individual company confidential data.

[4] Less than ½ unit.

for the delivery of 18 cubic feet of water per second.

The steel reinforced concrete pipe will have a 27-inch inside diameter.[13]

At Fierro, located 17 miles northeast of Silver City, Grant County, United States Smelting Refining and Mining Co. (USSR&M Co.) continued developing its principal mining facility, the new $22 million Continental mine and mill project. Results of the diamond-drill program which outlined the low-grade copper-zinc ore were reported. In the area scheduled for open pit mining south of the mill, 36 holes were drilled on a grid pattern of 200-foot squares. Here, ore reserves to a depth of 600 feet were estimated to be 16 million tons, averaging 1.06 percent copper after a provision for 10 percent dilution by rock containing 0.22 percent copper and an average 2-to-1 waste-to-ore ratio. Reserves to be recovered by underground mining in the southern zone and in the northern zone were estimated at 16 million tons, averaging 2.2 percent copper before a provision for dilution by waste material. These reserves were based on results from 17 drill holes in the northern zone and the deeper part of the southern zone.[14]

According to the USSR&M Co. annual report about 7 million tons of material was stripped at the open pit during 1968. This material included a stockpiled 335,000 tons of marginal-grade sulfide ore, about 325,000 tons of sulfide ore, and approximately 500,000 tons of oxide ore for future leaching. Stoping and development continued in the underground mine, particularly on the 600 and 800 levels at the No. 2 shaft and on the 850, 1,000, 1,150, and 1,300 levels at the No. 3 shaft. The company experienced problems in treating its copper-zinc ores in the new mill which was opened in 1967. The plant used the autogenous method of milling. Mechanical and metal-

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[13] Pay Dirt. No. 352, Oct. 28, 1968, p. 24.

[14] Skillings Mining Review. V. 57, No. 43, Oct. 26, 1968, p. 4.

Table 10.—Mine production of gold, silver, copper, lead, and zinc in 1968, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode ore:							
Dry gold-silver	3	3,086	1,047	48,401	9	3	1
Dry silver	4	414	-------	2,486	2	2	--------
Total [2]	7	3,500	1,047	50,887	12	5	1
Copper	6	6,697,079	4,931	114,766	102,577	12	455
Copper-zinc and lead-zinc [3]	4	65,299	340	13,751	2,199	24	1,486
Lead	1	43	1	97	(4)	10	--------
Zinc	4	245,454	278	45,157	313	2,669	35,425
Total	15	7,007,875	5,550	173,771	105,089	2,715	37,366
Other "lode" material:							
Copper cleanup	(5)	22	1	52	10	-------	--------
Copper precipitates	[6] 2	47,376	-------	-------	76,427	-------	--------
Lead-zinc cleanup	(5)	24	1	121	(4)	6	6
Total	2	47,422	2	173	76,437	6	6
Total "lode" material [2]	24	7,058,797	6,599	224,831	181,538	2,726	37,372
Placer	2	---------	31	35	-------	-------	--------
Total all sources	26	7,058,797	6,630	224,866	181,538	2,726	37,372

[1] Detail may not add to total because some mines produce more than one class of material.
[2] Data may not add to totals shown because of independent rounding.
[3] Combined to avoid disclosing individual company confidential data.
[4] Less than ½ unit.
[5] From properties not classed as mines.
[6] Operations at plants leaching runoff water not counted as producing mines.

Table 11.—Mine production of gold, silver, copper, lead, and zinc in 1968, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Concentration and smelting of concentrates: Ore	5,549	173,674	105,001	2,705	37,366
Direct smelting:					
Ore	1,050	51,157	48	15	1
Copper precipitates	---------	---------	76,427	---------	---------
Cleanup	---------	---------	10	6	6
Total [1]	1,050	51,157	76,485	21	6
Leaching of copper ore	---------	---------	51	---------	---------
Placer	31	35	---------	---------	---------
Grand total [1]	6,630	224,866	181,538	2,726	37,372

[1] Data may not add to totals shown because of independent rounding.

lurgical difficulties reported by the company prevented a continuous and consistent schedule; however, the mill at yearend was operating at near capacity, 3,000 tons per day. With economical recovery of zinc still a problem tests were underway to correct the difficulties in the zinc circuit. Copper concentrates were treated on a toll basis by American Smelting and Refining Co. The nearby Continental No. 1 underground mine, owned by USSR&M Co. and leased to L. A. Patten & Associates, continued to operate; as circumstances dictated, copper-zinc ores were shipped for processing at the new Continental mill or at the 400-ton-per-day Bayard flotation mill (Bullfrog mill) at Vanadium.

Federal Resources Corp. purchased the lease and equipment of the "85" copper mine from Diversified Mines, Inc.; the initial lease will be for 6½ years with an option for continuance. Located in the Lordsburg district (Virginia subdistrict), Hidalgo County, the "85" mine is adjacent to Federal's properties, the Bonney and the Miser's Chest-Little Annie mines. The "85" mine has a 2,000-foot, three-compartment shaft. Plans were to operate the four mines jointly and concentrate the ore at the 400-ton-per-day mill at the Bonney mine. During the year the Bonney mine shaft was deepened; two new stations were completed on the 1,800 and 2,000 levels. An underground connection between the Bonney mine and "85" mine was expected to relieve the water shortage at the mill, as well as provide additional ore production. Treatment of the copper ore from the Miser's Chest-Little Annie mines and the "85" mine kept the mill operating at 75 percent capacity.

Although copper was recovered from 33 operations in seven counties, Grant County with 12 active mines and 12 leaching operations, accounted for most of the output. Except for the leaching operations, all producers recovered one or more of the following metals as a byproduct or coproduct: gold, silver, lead, and zinc.

In further developments Kerr-McGee Corp. announced that exploration drilling in the Hanover Mountain area of Grant County had revealed high-grade copper ore; drilling was continued to determine the extent of the deposit. Reportedly, ore was intersected in a number of places in a drill hole, with a zone between the depths of 2,472 feet and 2,572 feet assaying over 2 percent copper. Kerr-McGee controls 6,300 acres of mining claims in the Hanover Mountain area.

The Goldfield Corp. revealed plans to reactivate the old San Pedro mine of Silver Bar Mining Co. Located in the New Placers (San Pedro) district in the southwest corner of Santa Fe County, the mine had produced copper, gold, and silver. It was reported that exploration had revealed new copper ore bodies. The company sought 115,000-kilowatt service for a planned 250-ton-per-day open pit-underground operation.

Copper Range Co. surrendered its options on properties located southwest of Tyrone in Grant County.

Gold.—The copper strike settled, gold production increased 28 percent; however, value increased 43 percent, partly due to the price gain from $35 per ounce to an average of $39.26 per ounce. Both the production and value were still under the 1965 high of recent years.

Gold was principally a byproduct of copper, lead, and zinc production. Most production came from the Continental and Chino mines, Grant County; the Bearup mine, Thomas Consolidated Mines, Inc., Catron County; and the Miser's Chest-Little Annie and "85" mines, Hidalgo County. Two gold placers were operated during the year—the Jicarilla group of the Jicarilla Placer Mill & Mining Co., in the Jicarilla area near Carrizozo, Lincoln County; and the Pine Grove Placer of C. J. Anderson, Grant County.

Iron Ore.—Dotson Minerals Corp. shipped magnetite ores mined by open-pit methods from the Jones mine in Socorro County and from the Midnight and State Lease mines in Lincoln County. All ores, ultimately shipped for use as a heavy aggregate in concrete, were upgraded in a plant at Carrizozo, Lincoln County.

Lead.—Lead production declined 25 percent with a value loss of 30 percent; the declines were partly due to labor problems at smelters and the drop in the price of lead from 14 to 13.212 cents per pound after the settlement of the strike. In most mines lead was produced as a coproduct with zinc. Copper and silver were also recovered as byproducts.

The New Jersey Zinc Co., a subsidiary of Gulf & Western Industries, Inc., operated or leased four mines: The State's leading lead-producing mine, the Linchburg, and also the Kelly mine, in the Magdalena mining district, Socorro County, and the Hanover and Oswaldo mines in the Central mining district, Grant County. Under a lease arrangement, L. A. Patten continued to operate the Linchburg, and A. B. Baca, the Kelly. The New Jersey Zinc Co. operated the Oswaldo under lease from Kennecott Copper Corp. Some production also came from the Princess mine of USSR&M Co. (Frank Van Cleave, lessee). Minor amounts were produced from eight operations in four counties.

Although some operators reported a decrease in lead output, other mines shipped for the first time or resumed operations.

Manganese Concentrate and Manganiferous Ore.—Manganese production increased in amount and value. Goret & Aguilar, Inc., obtained manganese ore from the Nancy No. 1 underground mine in the Socorro mining district. Before marketing, the ore was upgraded to a concentrate containing 48 percent manganese at a plant near Socorro, Socorro County. Luck Mining Co. continued to produce a ferruginous manganese ore containing 5 to 35 percent manganese from the open-pit Luck mine at Boston Hill outside of Silver City, Grant County. The ore was shipped direct to the CF&I Steel Corp. plant at Pueblo, Colo.

Molybdenum.—Production of molybdenum declined 8 percent, and the value was down 11 percent. The decrease was mainly caused by difficult milling conditions encountered during the processing of molybdenum ore from the Questa mine of Molybdenum Corporation of America (Molycorp). Also, shipments of byproduct molybdenum were lower at the Kerr-McGee Corp. uranium mill near Grants.

According to the 1968 Molycorp annual report, the Questa mine, Taos County, yielded 9.1 million pounds of molybdenum contained in the molybdenum disulfide concentrates, compared with 9.4 million pounds in 1967. Midyear modifications in the mill crushing circuit raised production from 4 million to 5.1 million pounds of molybdenum contained in the molybdenum disulfide concentrates. Moreover, the average daily mill rate was raised from 10,100 to 11,400 tons the last half of the year. The company announced that an extensive diamond-drilling program had delineated additional proved and/or probable ore reserves of 126.9 million tons with an average grade of 0.185 percent molybdenum disulfide. Up to June 30, 1968, open pit proved and probable ore reserves were estimated by the company to be 30.2 million tons, with an average grade of 0.189 percent molybdenum disulfide. Based on a 0.10 percent cutoff grade, an independent study by Utah Construction & Mining Co. for Molycorp, indicated reserves as follows: Proved ore, 111.2 million tons with an average grade of 0.186 percent, and probable ore, 45.8 million tons with an average grade of 0.188 percent. These additions brought total company reserves up to 157 million tons, with an average grade of 0.186 percent molybdenum disulfide.[15] Still under exploration drilling and evaluation is a newly discovered, potentially large, low-grade molybdenum deposit 6 miles from the Questa mine.

With a substantial increase in reserves assured, the company revealed plans to expand production to 14 million pounds per year by late 1969. Mill expansion and cost of removing preproduction waste material were being financed by a new $10 million bank loan and by revision of payback requirements of existing loans. New mining equipment valued at about $7.3 million was being obtained on a lease arrangement. The company planned to use seven electric shovels and 41 haulage trucks to mine more than 200,000 tons of ore and waste each day at the expanded mining operation. American Metal Market, September 30, 1968, noted that by late 1969, the additional facilities would make possible the delivery of 15,000 tons per day to the ball mills and flotation plant of the mill.

The operation employed 400 people and had a $3.5 million payroll during the year. An additional 100 persons are anticipated for the expansion.

During a program of continuing conservation, several thousand trout had been stocked in Turquoise Lake, a 65-acre tailings settling dam constructed by Molycorp. Within a year, the trout grew from fingerling size to 12 inches.

At midyear, to improve the recovery of molybdenite and copper, the milling flowsheet of Chino Mines was extended to include tailings sand-slime flotation. This tailings retreatment was expected to improve overall recovery. (See Copper Section.)

Silver.—Resumption of operations after the copper strike, the high price of silver, and consequent reopening of several mines accounted for the 43-percent increase in quantity and 98-percent rise in value. Silver averaged $2.1446 per troy ounce during the year.

Silver was recovered from silver ore, and as a coproduct of gold-silver ore, a byproduct of copper, copper-zinc, lead, lead-zinc and zinc ores, and from miscellaneous cleanups. Although total production was from 23 operations in seven counties, output was mainly from Grant, Catron, Hidalgo, and Socorro Counties. Leading silver producing mines were the Continental, Bearup, Chino, Miser's Chest-Little Annie and "85", and the Princess.

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[15] Harder, Lewis B., and William R. Kuntz. Molybdenum Corporation of America. Interim Report for the Periods Ended June 30, 1968. Aug. 1, 1968.

Uranium.—Value of recoverable uranium oxide shipped during the year increased $5.5 million, 6 percent over 1967 shipments. In the United States 14.7 million pounds of U_3O_8 in uranium concentrates, valued at $117 million, were purchased by the AEC during 1968. New Mexico provided 8.6 million pounds or 58.5 percent valued at $68.8 million (down $6.3 million from 1967 purchases). Companies in the State, however, shipped a total of 12.3 million pounds of uranium oxide valued at $95.1 million, thus reflecting sales of concentrates to private industry.

Activities including prospecting, exploration, development of new mines, and expansion of existing facilities were at high levels. AEC announced uranium ore reserves in the western United States at yearend were estimated at 70.3 million tons. The ore had an average grade of 0.23 percent U_3O_8 and contained 161,000 tons of U_3O_8, considered recoverable at $8 or less per pound. New Mexico uranium reserves as of December 31 were estimated at 29.4 million tons of ore, averaging 0.25 percent U_3O_8, or 41.8 percent of the total in the United States.

The increase in reserves was the result of surface exploration and development drilling which amounted to 4.5 million feet in New Mexico, or 18.9 percent of the total 23.8 million feet drilled for uranium nationwide. In 1967 exploration and development drilling in the State totaled 3.1 million feet.

Uranium production came from 56 operations in three counties. McKinley County accounted for 52 operations with a total value of production amounting to $69.2 million. San Juan and Valencia Counties had two operations each.

The Anaconda Company made its first commercial delivery of uranium concentrates from the company mill near Grants; all previous output had been sold to AEC. The company operated the open-pit Jackpile-Paguate mine in Valencia County.

Major production came from the five underground mines of Kerr-McGee Corp—Sections 17 & 20, 22, 24, 30, and Branson 33—in the Ambrosia Lake district, McKinley County. Two new mines being developed by the company are to be completed in 1969; production is scheduled to begin in 1970, bringing to seven the number of Kerr-McGee mines operating in the area. A third new mine was expected to be under construction in 1969. The capacity of Kerr-McGee's Ambrosia Lake mill was raised to 6,000 tons per day; plans were announced to increase the capacity to 7,000 tons per day. Under 6-year contracts totaling almost $95 million, the company will deliver 15.3 million pounds of concentrates at $6.19 per pound for use by utilities.[16]

New ownership agreements of Homestake-Sapin Partners and United Nuclear Corp. were amended to provide United Nuclear Corp. with 70 percent interest and Homestake Mining Co. 30-percent interest in a new partnership to be known as United Nuclear-Homestake Partners. Homestate Mining Co. will continue to operate the partnership's mines located in the Ambrosia Lake area near Grants. In the agreement provision was made to distribute to the partners the uranium concentrate produced in excess of the requirements needed to fulfill existing AEC contracts and for the partners to share in the available mill capacity for their individual accounts.

United Nuclear-Homestake Partners operated five underground mines known as Sections 15, 23, 25, 29, and 32, all in the Ambrosia Lake area. Production, scheduled to be 300 tons per day, was begun at the new mines Mac No. 1 and Mac No. 2 in the Smith Lake area, northwest of Grants. The partners operate one of the largest uranium concentrate mills in the United States.

In the Church Rock area, about 16 miles northeast of Gallup, the new 1,800-foot shaft of United Nuclear reached a depth of 1,600 feet. About 30 miles east of the Arizona border, the company's mining lease involves two sections of land bordering the Navajo Reservation in McKinley County. Reportedly, Kaiser Engineers Division, Kaiser Industries Corp. of Oakland, Calif., was selected to design a 3,000-ton-per-day mill expected to cost about $10 million. Construction was scheduled to cleanups. Although total production was from 23 operations in seven counties output area by 600 to 700 persons. In its annual report for fiscal year ending June 30, 1969, United Nuclear had uranium concentrate orders and options in excess of $375 million, chiefly for use by power utilities. A $1,783,000 grant from the Federal Economic Development Administration and $445,800 in State money will be used to build a road from Church Rock to the United Nuclear site and to provide access to the nearby Indian ceremonial grounds. Other mines operated by United Nuclear during the year included the San Mateo in Valencia County and the Ann Lee, Sandstone, Sections 27 East and 27 West, all in McKinley County. The Cliffside (sec 36) and Section 1 mines were operated the first half of the year by United Nuclear and by Magna Oil Corp. the last half.

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[16] University of New Mexico, Bureau of Business Research. The State's Economy in 1968. New Mexico Business, v. 22, No. 3, March 1969, p. 6.

In addition, the following mines were operated in McKinley County: the Flea and Dog mines of Four Corners Exploration Co.; the National Energy-DeVilliers No. 1 mine of DeVillers Nuclear Corp.; White Cap Claim (sec 30), Mesa Top 19, and Barbara J mines of Farris Mines, Inc.; Evelyn mine, operated part of the year by Farris Mines, Inc., and part of the year by Petrodynamics, Inc.; Blue Peak mine of Garcia Mines; and the Bencenti mine of Shiprock, Ltd. Mines operated in San Juan County were the Rattlesnake mine of Goode Mining & Exploration, Inc., and the Enos Johnson mine of Ray L. Williams Mining Co.

Ranchers Exploration and Development Corp. entered a joint-venture agreement with Houston Natural Gas Corp., Houston, Tex., and Combustion Engineering, Inc., New York. Exploration of approximately 250,000 acres was to entail an expenditure of $3 million over a 3-year period, with Ranchers contributing the acreage and $750,000 for 50 percent participation; and Combustion Engineering and Houston Natural Gas $2,250,000 for 25 percent interest each. Direction of the exploration program and operation of any mines developed would be the responsibility of Ranchers. In late 1968 the companies announced uranium mineralization was found in three of 11 holes drilled within a 640-acre tract in the northwest section of the State. Encountered at a depth of 1,375 feet, mineralization was of sufficient thickness and grade to warrant further close-space drilling.

DeVilliers Nuclear Corp. and Standard Oil of Ohio announced a joint-exploration effort on leases in the Ambrosia Lake area. In three drill holes, uranium mineralization ranging 6 to 18 feet thick was found on section 18 in Ambrosia Lake township. Ore was also discovered on section 8; development drilling was continued to determine the extent of the deposit. In a joint agreement with National Energy Corp., DeVillers took over operation of the E. P. Moe mine.

American Uranium Corp., formerly known as American Mining and Oil Co., acquired properties in the Chama basin of Rio Arriba County and in the Ambrosia Lake area of McKinley County. The company announced 200 exploratory holes had revealed a fair amount of ore on the northern edge of the Laguna Indian Reservation; consequently, a new mill for the area was under consideration. Exploration drilling will continue another year.

In a joint venture, Keradamex, Inc., a subsidiary of Kerr Addison Mines, Ltd. (Canada), with 26-percent interest; Norandex Inc., a subsidiary of Noranda Mines, Ltd. (Canada), with 25-percent interest; and Amerada Petroleum Corp. with 49-percent interest acquired a lease covering the 250,000-acre Fernandez Ranch northeast of Grants. Four of 17 deep-drilled, widely spaced exploration holes encountered enough mineralization at 2,600 feet to justify closer spaced drilling. Though not completely delineated, 41 shallow drill holes reportedly indicated an estimated potential ore zone containing 1.35 million tons of ore, with a radiometrically logged grade of 2.3 pounds per ton U_3O_8. At a 900-foot depth, the ore averages 11.5 feet thick.

Other large blocks of land were leased or purchased for exploration. Reserve Oil & Minerals Corp. purchased the 120,000-acre L-Bar Ranch west of Albuquerque for $3.4 million; exploration was planned on 57,000 acres. Western Energy Corp. acquired a 394,284-acre block of leases for exploration.

In other developments, the New Mexico Health and Social Services Department received a $35,000 Federal grant to operate the Dakota mine in the Ambrosia Lake area, McKinley County, as a research laboratory. Economically feasible methods of lowering levels of radiation exposure will be studied in the mine leased through the Bureau of Indian Affairs.

Acquired by Foote Mineral Co. in the 1967 merger with Vanadium Corporation of America (VCA), the Shiprock uranium mill was shut down because of a shortage of high-grade ores and the high cost of materials and supplies. The mill, located near Shiprock in San Juan County, was built by Kerr-McGee Oil Industries, Inc., in 1954 and sold to VCA in 1963. The mill capacity was 400 tons per day and employed about 75 people. Foote Mineral Co.'s annual report noted the plant facilities became fully depreciated at the end of 1968; however, permanent status of the facilities was uncertain and efforts were being made to obtain more than salvage value out of the equipment. When the mill closed the company leased its uranium-vanadium properties on the Colorado Plateau to Climax Uranium Co., a division of American Metal Climax, Inc., for operation on a royalty basis. Provisions were made for Foote to purchase vanadium pentoxide produced from the mines.

Vanadium.—The midyear closing of the Shiprock mill caused a 68-percent drop in vanadium production for the year and a value loss of 74 percent.

Vanadium-bearing uranium ores were shipped from the Bencenti mine of Shiprock, Ltd., McKinley County, and from the Enos Johnson mine of Ray L. Williams Mining Co., San Juan County. The ores and vanadium-rich liquids recovered at uranium mills not having vanadium recovery circuits were processed at the Shiprock mill of Foote Mineral or at facilities of Union Carbide Corp. in Colorado.

Zinc.—Zinc production continued lower in value and amount from a high reached in 1965. Decreases from 1967 production amounted to 2,694 short tons, resulting in a decline in value of $874,000.

The New Jersey Zinc Co., with major production from the Hanover and Oswaldo mines in Grant County and the Linchburg mine in Socorro County, continued to be the State's leading producer. Significant output also came from the Princess, Continental No. 1, and Continental mines of USSR&M Co., all located in Grant County. In Socorro County, the Kelly mine of The New Jersey Zinc Co. (A . B. Baca, lessee) continued to ship. Zinc was recovered from 11 operations in Catron, Grant, Hidalgo, and Socorro Counties. At the Princess mine, according to the USSR&M Co. annual report, production of zinc ore on a contract basis was supplemented by ore from the Mabel section. The report also noted that grade was down slightly and that reserves were approaching a critical level. The area to the southwest of the Princess shaft was explored by drilling from the 1,500-foot level.

NONMETALS

The $27.7 million decline in the production of potassium salts (potash) was the major factor in the 22-percent decrease in value of nonmetals production. The value of potash output, $63.4 million, was the lowest since 1953. Much smaller declines were noted in sand and gravel, pumice, gypsum, mica, and gem stones. Increases in value of cement ($1.5 million), stone ($1.1 million), and smaller gains in perlite, lime, clays, fluorspar, and feldspar did not begin to make up the decline in the potash industry.

Barite.—Ed J. Powell stockpiled a small amount of barite and galena from the Alameda mine, Sandoval County. Some exploration was reported on a barite prospect near Animas, Hidalgo County.

Cement.—Value of portland cement shipments increased $1.5 million. Output of both masonry and portland cements rose with the increase in demand by the construction industry, highway contractors, concrete manufacturers, ready-mix firms, Federal and State agencies, and others. Use by building materials dealers was down slightly. Portland and masonry cements were produced east of Albuquerque at the Tijeras plant of Ideal Cement Co. Division, Ideal Basic Industries, Inc. Most cement was marketed in New Mexico and Colorado; however, some was shipped to Texas, Oklahoma, and Arizona.

Clays.—Because of a rise in construction activity, production of clay increased 43 percent, and value 20 percent. Leading the State in output was Bernalillo County, where Ideal Cement Co. mined and processed clay for making cement at Tijeras, and Kinney Brick Co., Inc., of Albuquerque mined clay used for building brick. Clay for brick was also produced in Dona

Ana County by El Paso Brick Co. and in Taos County by Louis O. Romero. U.S. Mining Corp., McKinley County, mined clays which were utilized as a rotary-drilling mud. In Luna County, Mathis & Mathis continued to produce clays for saggers and pins. All reported deposits, many not requiring drilling and blasting, were open-pit mined.

Feldspar.—All feldspar production in the State came from pegmatites in Rio Arriba County. Los Compadres Mica Co. mined feldspar from the Joseph, Globe, Star and other deposits. C. A. Morris & Co., Inc., shipped feldspar from the Cribbenville mine.

Fluorspar.—North Star Mining & Milling Corp. continued to produce a small amount of fluorspar from the Bishops Cap mine in Dona Ana County.

Gypsum.—Gypsum output decreased slightly in quantity and value. In the calcined form, gypsum is used primarily for manufacturing wallboard, lath and building plaster; raw or uncalcined, most of it is used as a set retarder in portland cement and a small amount for soil conditioning.

Gypsum was produced at five surface mines. Kaiser Gypsum Co., Inc., mined gypsum near its wallboard plant at Rosario south of Santa Fe. From an open pit near San Ysidro, Sandoval County, White Mesa Gypsum Co. continued to mine gypsum which was calcined at the American Gypsum Division, Susquehanna Corp., plant near Albuquerque. Near Bernalillo, Sandoval County, Duke City Gravel Products Co. mined gypsum which was purchased by Ideal Cement Co. for use as a portland-cement retarder. Associated Materials Co. of Las Cruces and Charles Swank of Truth or Consequences, Sierra County, each produced a small amount for agricultural purposes.

A plant for production of dry-wall mat was under construction by Frontier Enterprises of New Mexico at Regina, 7 miles north of La Jara, Sandoval County. Startup was expected in 1969.

Lime.—Lime produced and used by Chino Mines, the only producer in the State, increased 59 percent to 27,000 tons. Resumption of milling operations by Chino Mines at Hurley, Grant County, resulted in the need for more lime used in treating copper ores. Limestone used for making the lime was from the company quarry at the millsite.

Mica.—Scrap-mica production and value decreased 18 and 46 percent, respectively. Located in Taos County, Mineral Industrial Commodities of America, Inc., became the only producer of scrap mica in the State at its Tojos mine. At its dry-grinding plant north of Santa Fe, the company prepared the mica for use in paints and roofing. Mica used for roofing purposes was processed by Sunshine Mica Co. in its new dry-grinding operation at Las Vegas, San Miguel County.

Perlite.—New Mexico continued to be the leading producer of crude perlite. Obtained from four operations, perlite output increased 5 percent, and the value 8 percent.

Most mines were located in northern Taos County where three companies mined and milled the perlite; the material was trucked some 20 to 36 miles to loading and blending facilities at the railhead, Antonito, Colo. Grefco, Inc., also had an expanding plant at Antonito. Mine-mill complexes located on No Agua Mountain, 7 miles north of Tres Piedras, Taos County, included the Seven Hills mine of Johns-Manville Perlite Corp., and the El Grande mine of Grefco, Inc. Ten miles north and 14 miles east of Tres Piedras, at a deposit similar to the No Agua Mountain occurrence, was the United Perlite Corp. complex. In Valencia County, United States Gypsum Co. shipped perlite from the Hill No. 7 quarry, near Grants.

Markets for expanded perlite included building-plaster aggregates, filter aids, concrete aggregates, insulations, and soil conditioners.

Table 12.—Crude perlite sold or used by producers

Year	Short tons	Value (thousands)
1964	286,329	$2,568
1965	331,011	2,905
1966	343,334	3,423
1967	346,586	3,424
1968	365,481	3,706

Potash.—Although consumption of potassium salts (potash) in the United States continued to increase, output in New

Mexico in 1968 declined 21 percent and value of production declined $27.7 million, a 30-percent drop. Representing a decrease of 46 percent in 3 years, production was valued at $63.4 million, compared with the alltime high of $117.8 million recorded in 1965. About 94 percent of domestic potash produced was used in fertilizers.

The competitive position of the New Mexico industry was eroded when the vast, rich deposits of Canada came into production without the expected development of the world market. The resulting rapid deterioration of prices severely reduced the profit margin of ores produced in the Carlsbad basin.

Changing ownership patterns reflected the unsettled condition of the industry. In August Continental American Royalty Co. purchased the Carlsbad properties of United States Borax & Chemical Corp. The operation, mainly located about 16 miles southeast of Carlsbad, Eddy County, had been closed since November 1967. Although no purchase price was announced, the properties were reported to have had a value over $5 million. Acquisition included the mine, mill, office building in Carlsbad, and water rights, as well as approximately 9,500 acres of land owned in fee, 5,000 acres covered by State or Federal oil and gas leases, and 37,000 acres covered by State and Federal potash leases. Sulfur rights are included in 30,000 acres. Recoverable potash reserves have been reported to be 4.4 million tons of high-grade ore and 200 million tons of lower grade ore.[17] The operating company, U.S. Potash and Chemical Co., a subsidiary of Continental American Royalty Co., commenced production the last of August. Annual output was expected to reach 300,000 tons per year. The new company employed about 180 people; 850 were terminated when the previous company shut down in 1967.

Kerr-McGee Corp. acquired the outstanding 50-percent interest in Kermac Potash Co. owned by National Farmers Union Development Corp. Located 40 miles southwest of Hobbs, Eddy County, the mine and mill, known as Hobbs Potash Facility, became a part of Kerr-McGee's operations.

Pennzoil United, Inc., formed in 1968 by merging Pennzoil Co. and United Gas Corp., acquired enough shares of Duval Corp., formerly a subsidiary of United Gas Corp., to bring the company's ownership in Duval to more than 99 percent. Duval Corp. continued to operate the Nash Draw mine and the Saunders mine in Eddy County. Langbeinite (a potassium-magnesium sulfate mineral) ores were obtained from the Nash Draw in the southern part of the potash basin; sylvite ores from the Saunders in the center of the basin.

International Minerals & Chemical Corp. (IMC) facilities, 25 miles east of Carlsbad, Eddy County, included the mine with four shafts to service and ventilate the mining levels, a refinery and chemical plant, product warehouses, shops and office buildings. Nearing completion at yearend was a new $2 million plant for the treatment of mixed sylvite and langbeinite ores. Previously unprofitable, the mixed ores were to be brought into production by utilizing a new refining process. Additional construction consisted of a new 16-mile, 22-inch waterline from La Huerta to the mine. For

Table 13.—Potassium salt production and sales

(Thousand short tons and thousand dollars)

Year	Crude salts, mine production		Marketable potassium salts					
			Production			Sales		
	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Value	Gross weight	K_2O equivalent	Value
1964	17,356	3,122	4,585	2,675	$104,861	4,815	2,814	$110,772
1965	18,557	3,363	4,919	2,848	117,771	4,607	2,677	110,424
1966	20,105	3,528	5,096	2,953	108,653	4,872	2,827	104,668
1967	18,906	3,434	4,950	2,883	91,098	4,797	2,784	88,788
1968	14,382	2,564	4,051	2,289	63,406	4,425	2,511	70,198

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[17] Page 8 of work cited in footnote 16.

protection, the pipe was wrapped outside and epoxy coated inside.

The profit loss in fiscal 1968, reported by IMC to the stockholders, reflected the sharp decline in the price of potash caused by the oversupply of Saskatchewan potash. For the first time nonagriculture sales exceeded fertilizer sales by 55 percent of the total. In 1966 agriculture sales were 71 percent of the company's total sales. Compensating adjustments were the acquisition of several companies, including Continental Ore Corp., an international trading company dealing with ores, minerals, ferroalloys, metals, and carbon products. Reportedly, the merger would immediately increase total corporate sales and profits, strengthen overseas markets, and permit diversification into other minerals and metals.[18]

In other developments during the year IMC rehired about 75 of the 305 employees laid off in 1967.

Methods of achieving greater efficiency and safety in the 13,000-ton-per-day mine were described.[19] Over a 5-year period, 1962 to 1967, the operation achieved a 20-percent decrease in production costs and a dramatic decrease in the accident-frequency rate.

In the annual report of Freeport Sulphur Co., its subsidiary, National Potash Co., noted a small profit despite declining prices. The company continued to produce from the Eddy mine at the western edge of the potash basin in Eddy County and from the Lea mine, 15 miles to the east in Lea County.

According to the annual report of American Metal Climax, Inc., deliveries of muriate of potash from its Southwest Potash Division Carlsbad mine and mill exceeded the output of 1967 by 13 percent. Continued erosion in prices in both domestic and foreign markets, however, resulted in decreased dollar sales for the muriate business.

Ideal Basic Industries, Inc., in its company annual report, indicated slightly higher shipments of potassium salts by its Potash Company of America Division; sales revenue, however, declined due to price deterioration. While domestic deliveries were down a small amount, some improvements in exports compensated for the loss.

As of December 31, the seven companies operating in the State had stocks on hand totaling 442,571 short tons of K_2O equivalent contained in 785,434 short tons of product. Production during the year was 2.3 million short tons of K_2O equivalent salts; sales were 2.5 million tons.

Pumice.—Output of pumice, all from open pits, increased 10 percent, but value dropped 18 percent. Tabulated statistics of pumice include such volcanic material as scoria and volcanic cinders. Production and sales of these materials remained about the same as in the previous year. Output of pumice came from General Pumice Corp., Rio Arriba County; Utility Block Co., Sandoval County; and Copar Pumice Co., Inc., Santa Fe County. Volcanic cinder was mined by American Pozzolan Corp., Associated Materials Co., Builders Block and Supply Co., Inc., and Volcanic Cinder Co., all of Dona Ana County; and Garcia & Son of San Juan County. Scoria was produced by Edgar D. Otto & Son, Inc., Bernalillo County; Twin Peaks Products Co., Lincoln County; Los Compadres Mica Co., Rio Arriba County; Crego Block Co., Inc., and Kauffman Trucking Co., Santa Fe County; and Industrial Minerals, Inc., and Twin Mountain Rock Co., Union County.

These companies sold pumice principally for use as concrete aggregates and some for cleaning and scouring purposes, roofing aggregate, and landscaping. Scoria was used mainly for railroad ballast and for concrete aggregates, roofing, and landscaping materials; nearly all volcanic cinder was marketed for concrete aggregate, with small quantities sold for oil well cementing, concrete admixture, landscaping, steel pipe lining, and roofing.

Salt.—Once again the amount and value of salt shipments increased. Salt continued to be recovered as a byproduct of potash operations, Eddy County accounting for all production in the State. New Mexico Salt Co. and The Salt Supply Co., Inc., of Carlsbad remained the leading salt shippers. Pioneer Water Co. of Eunice sold brackish water from open lakes in Eddy County.

Markets for salt—sold as rock salt, pressed block, and brine—were feed dealers, feed mixers, oil refiners, and various State, county, and other government agencies, excluding Federal agencies. Most salt was marketed in New Mexico and Texas; some was shipped to Arizona, Colorado, and Oklahoma.

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[18] Chemical Week. IMC Profits Plunge. V. 103, No. 18, Nov. 2, 1968, p. 18.

[19] Hougland, R. W. Improving Safety and Productivity in Potash Mining. Min. Cong. J., v. 54, No. 7, July 1968, pp. 45–49.

Sand and Gravel.—Sand and gravel operations in 31 counties totaled 158, compared with 165 in 1967. Output of sand and gravel decreased 16 percent and value dropped 14 percent: from 14.7 million tons valued at $14.3 million in 1967 to 12.3 million tons valued at $12.4 million in 1968. Production ranged in value from the $2 million-plus figure for Bernalillo and Dona Ana Counties, down to less than $100,000 in Colfax, Eddy, Guadalupe, Lincoln, Quay, Roosevelt, San Miguel, Union, and Los Alamos Counties. No production was recorded for Curry County. Government-and-contractor operations accounted for 8.7 million tons or 71 percent of the total 12.3 million-ton output; commercial operators produced the remainder.

Of the total amount of sand and gravel sold or used, 7.7 million tons or 62 percent was processed by washing, screening, or otherwise treated, and 4.6 million tons or 38 percent was sold unprocessed. The material was processed at 55 portable plants and 42 stationary plants.

Of the 10.9 million tons of gravel produced, 9.8 million was used for road construction and 1 million for building construction; 521,000 of the 1.3 million tons of sand was also used for road construction and 773,000 tons for building construction. Only small amounts of sand and gravel were used in fill, railroad ballast, and other miscellaneous uses.

Two operators each produced over 1 million tons of sand and gravel; 12 produced over 200,000 tons each.

Stone.—Increased construction resulted in a 60-percent gain in the output of stone. Value gain was 47 percent. Fifty quarries were operated in 23 counties, compared with 58 quarries also in 23 counties in 1967. Again, limestone (1.6 million), miscellaneous stone (300,418 tons), sandstone (189,366 tons), and basalt (97,854 tons) comprised most of the stone production. Output of crushed and broken stone of all kinds amounted to 2.2 million tons valued at $3.5 million; 3,701 tons of dimension stone was valued at $44,259.

Table 14.—Sand and gravel production in 1968, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Bernalillo	1,967	$2,787
Catron	276	288
Chaves	109	180
Colfax	60	91
De Baca	W	W
Dona Ana	2,976	2,088
Eddy	102	51
Grant	180	177
Guadalupe	89	49
Harding	108	140
Hidalgo	418	291
Lea	W	W
Lincoln	27	14
Los Alamos	12	17
Luna	1,488	982
McKinley	240	808
Mora	177	219
Otero	653	768
Quay	87	50
Rio Arriba	251	257
Roosevelt	W	W
Sandoval	402	521
San Juan	433	511
San Miguel	55	68
Santa Fe	164	278
Sierra	688	705
Socorro	377	455
Taos	95	181
Torrance	352	216
Union	14	21
Valencia	866	450
Undistributed	261	408
Total	12,262	12,396

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Table 15.—Sand and gravel sold or used by producers, by classes of operations and uses[1]

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	806	$1,006	708	$909
Paving	172	210	448	518
Railroad ballast	--------	--------	2	1
Fill	[2] 33	[2] 23	30	21
Industrial:				
Blast	(2)	(2)	1	2
Engine	--------	--------	3	2
Total	1,011	1,239	1,192	1,453
Gravel:				
Construction:				
Building	864	1,354	915	1,496
Paving	1,133	1,415	1,374	1,847
Fill	89	45	27	16
Other	--------	--------	1	1
Miscellaneous	48	56	14	17
Total	2,134	2,870	2,331	3,379
Total sand and gravel	3,145	4,109	3,523	4,832
Government-and-contractor operations:				
Sand:				
Building	--------	--------	65	65
Paving	248	228	73	93
Other	5	7	3	2
Total	253	235	141	160
Gravel:				
Building	--------	--------	124	155
Paving	11,048	9,878	8,440	7,229
Fill	226	114	29	16
Other	--------	--------	5	3
Total	11,274	9,992	8,598	7,403
Total sand and gravel	11,527	10,228	8,739	7,564
All operations:				
Sand	1,264	1,474	1,333	1,613
Gravel	13,408	12,862	10,929	10,782
Total	14,672	14,336	12,262	12,396

[1] Data may not add to totals shown because of independent rounding.
[2] Fill and blast sand combined to avoid disclosing individual company confidential data.

Table 16.—Stone production in 1968, by counties

County	Short tons	Value	County	Short tons	Value
Bernalillo	W	W	Otero	5,000	$3,500
Catron	7,727	$13,522	Rio Arriba	129,955	248,575
Chaves	37,957	28,462	San Juan	640	1,280
Colfax	325,423	606,270	San Miguel	244	4,418
Curry	118,660	250,520	Santa Fe	61,544	75,000
Dona Ana	128	224	Sierra	1,572	2,751
Eddy	W	W	Socorro	4,553	16,956
Grant	63,247	W	Taos	25	250
Hidalgo	W	W	Torrance	W	W
Lea	266,388	260,469	Valencia	22,675	58,700
Lincoln	W	W	Undistributed	1,077,303	1,749,852
Luna	5	120			
McKinley	103,067	206,134	Total	2,226,113	3,527,003

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Table 17.—Stone sold or used by producers, by kinds[1]

(Thousand short tons and thousand dollars)

Kind of stone	1964		1965		1966		1967		1968	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Dolomite and limestone	1,261	$1,936	1,452	$2,084	1,479	$2,089	649	$919	[2] 1,637	[2] $2,657
Dolomite	NA	NA	NA	NA	NA	NA	NA	NA	(2)	W
Limestone	NA	NA	NA	NA	NA	NA	NA	NA	1,637	2,657
Granite	(3)	4	3	17	W	W	(3)	16	(3)	3
Marble	W	W	W	W	W	W	W	W	1	23
Quartz, quartzite, and sandstone	[4] 7	[4] 10	(3, 5)	[5] 2	325	493	75	132	189	[6] 320
Quartz and quartzite	NA	NA	NA	NA	NA	NA	NA	NA	(3)	W
Sandstone	NA	NA	NA	NA	NA	NA	NA	NA	189	320
Traprock	43	81	84	248	136	275	[7] 69	[7] 110	W	W
Other stone	1,449	2,212	371	668	712	1,199	598	1,226	398	528
Total	2,760	4,244	1,911	3,020	2,652	4,056	1,391	2,403	2,226	3,527

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Other stone."

[1] Data may not add to totals shown because of independent rounding.

[2] Subdivided in 1968 into dolomite and limestone; quantity and value of dolomite excluded to avoid disclosing individual company confidential data.

[3] Less than ½ unit.

[4] Excludes dimension sandstone; included with "Other stone."

[5] Excludes crushed sandstone; included with "Other stone."

[6] Subdivided in 1968 into quartz and quartzite and sandstone; value of quartzite excluded to avoid disclosing individual company confidential data.

[7] Excludes dimension traprock; included with "Other stone."

Crushed and broken limestone, produced in Bernalillo, Catron, Colfax, Curry, Dona Ana, Eddy, Grant, Hidalgo, Lea, McKinley, Otero, Sierra, Socorro, and Torrance Counties, was used principally as dense graded roadbase stone and in cement; smaller amounts were utilized for surface treatment aggregate, riprap and jetty stone, making lime, manufactured fine aggregate (stone sand), flux, terrazzo, exposed aggregate, and roofing aggregate, chips, and granules.

Crushed and broken sandstone was quarried in Bernalillo, Luna, Rio Arriba, San Juan, San Miguel, Santa Fe, Socorro, Taos, Torrance, and Valencia Counties. Most production was used for riprap, jetty, and roadbase stone; lesser amounts were used for flagging, house veneer, and cut stone.

Basalt (traprock) used for rough blocks was produced in Lincoln County. Crushed and broken basalt was produced in McKinley and Valencia Counties.

Other output of stone included dolomite, Grant County; granite, San Miguel County; quartzite, Rio Arriba County; and miscellaneous stone, Chaves, Lea, Lincoln, Rio Arriba, and Socorro Counties. Marble was quarried in Bernalillo and Valencia Counties.

Crushed and broken stone ranged in value from $0.70 to $3.40 per ton; dimension stone from $3 to $33.

Sulfur.—Of the 26,115 long tons of byproduct sulfur produced, 24,914 tons was shipped at a total value of $973,863, representing a 35-percent increase in shipments and a 60-percent gain in value. In 1967 shipments were 18,456 long tons valued at $609,304.

Because of the difficulty in determining the State of origin of byproduct sulfur recovered at natural gas plants and petroleum refineries, particularly on the eastern seaboard and at the gulf ports, the quantity and value of sulfur recovered from these sources were not included in the mineral-production statistics in table 1.

All output was recovered as a byproduct at five natural gas processing plants in three counties. The following used the modified Claus process: Near Artesia, Eddy County, the Indian Basin plant of Marathon Oil Co. and the Empire Abo plant of Pan American Petroleum Corp.; and near Monument, Lea County, the Climax Chemical Co. plant. The Phillips Petroleum Co. Artesia plant in Eddy County and the Cities Service Oil Co. Bluitt plant near Milnesand, Roosevelt County, both used the standard Claus process.

Leases for sulfur exploration were acquired in Eddy County near the border of Culbertson County, Tex., where newly discovered, naturally occurring sulfur deposits were being mined. Stolz and Co. of Midland, Tex., leased 97,000 acres in southcentral Eddy County; then Texas-American Sulfur Co. leased 45,880 of those acres.[20]

Vermiculite.—Vermiculite was shipped to Southwest Vermiculite Co. near Albuquerque for exfoliation. The material was used mainly in lightweight aggregate and also as insulation fill and for other miscellaneous uses.

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[20] Page 9 of work cited in footnote 16.

Table 18.—Principal producers

Commodity and company	Address	Type of activity	County
Beryllium: Pennsylvania Glass Sand Corp.	Hancock, W. Va. 25424	Underground mine	Taos.
Carbon dioxide (natural):			
Schwartz Carbonic Co	Box 9737 El Paso, Tex. 79987	Well and extraction plant.	Harding.
S. E. C. Corp	do	do	Do.
Cement: Ideal Cement Co., a division of Ideal Basic Industries, Inc.	620 Ideal Cement Bldg. Denver, Colo. 80202	Dry-process, 2-rotary-kiln plant.	Bernalillo.
Clays:			
El Paso Brick Co	Box 12336 El Paso, Tex. 79912	Open pit mine	Dona Ana.
Ideal Cement Co	620 Ideal Cement Bldg. Denver, Colo. 80202	do	Bernalillo.
Kinney Brick Co., Inc	Box 1804 Albuquerque, N. Mex. 87103	do	Do.
Coal:			
Kaiser Steel Corp	Box 1107 Raton, N. Mex. 87740	Underground mine, crushing plant, dense media-froth flotation cleaning plant.	Colfax.
The Pittsburg & Midway Coal Mining Co.	Box M Gallup, N. Mex. 87301	Strip mine, crushing plant, chemical and water treatment plant.	McKinley.
Utah Construction & Mining Co.	Box 155 Fruitland, N. Mex. 87416	Strip mine, crushing plant, dust suppression detergent treatment plant.	San Juan.
Copper:			
Federal Resources Corp	1370 S. Third W. Salt Lake City, Utah 84115	3 underground mines and mill.	Hidalgo.
Kennecott Copper Corp., Chino Mines Division.	Hurley, N. Mex. 88043	Open pit mine, flotation mill, precipitation plant, smelter, refinery.	Grant.
United States Smelting Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	Underground mine, open pit-underground mine, flotation mill.	Do.
Feldspar:			
C. A. Morris & Co., Inc	Box 4473 Santa Fe, N. Mex. 87501	Open pit mine	Rio Arriba.
Los Compadres Mica Co	Box 475 Ojo Caliente, N. Mex. 87549	2 open pit mines	Do.
Fluorspar: North Star Mining & Milling Corp.	Box 1177 Las Cruces, N. Mex. 88001	Open pit mine	Dona Ana.
Gold:			
Kennecott Copper Corp., Chino Mines Division.	Hurley, N. Mex. 88043	*See* Copper	Grant.
United States Smelting Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	do	Do.
Gypsum: White Mesa Gypsum Co.	124 Jackson NE Albuquerque, N. Mex. 87108	Open pit mine	Sandoval.
Helium: Navajo Indian Tribe (Air Reduction Co., operator).	Shiprock, N. Mex. 87420	Extraction plant	San Juan.
Iron ore: Dotson Minerals Corp	Box 115 Socorro, N. Mex. 87801	2 open pit mines and magnetic upgrading plant.	Lincoln.
		Open pit mine	Socorro.
Lead: The New Jersey Zinc Co	160 Front Street New York, N. Y. 10038	*See* Zinc	Do.
Lime: Kennecott Copper Corp., Chino Mines Division.	Hurley, N. Mex. 88043	Rotary kiln	Grant.
Manganese concentrates: Goret & Aguilar, Inc.	Box 282 Socorro, N. Mex 87801	Underground mine and jigging plant.	Socorro.
Manganiferous ore: Luck Mining Co.	215 Market Street San Francisco, Calif. 94105	Open pit mine	Grant.

Table 18.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Mica: Mineral Industrial Commodities of America, Inc.	Box 2403 Santa Fe, N. Mex. 87501	Open pit mine Dry grinding plant	Taos. Santa Fe.
Molybdenum: Molybdenum Corporation of America.	280 Park Avenue New York, N.Y. 10017	Open pit mine and flotation mill.	Taos.
Natural gas and petroleum: [1]			
Peat: T. L. Fox	506 Rosemont NE Albuquerque, N. Mex. 87107	Humus bog	Sandoval.
Perlite:			
Grefco, Inc., Building Products Division.	630 Shatto Place Los Angeles, Calif. 90005	Open pit mine; crushing, screening, and air-separation plant.	Taos.
Johns-Manville Perlite Corp.	Lompoc, Calif. 93436	do	Do.
Potash:			
Duval Corp	Box 511 Carlsbad, N. Mex. 88220	2 underground mines and refinery.	Eddy.
International Minerals & Chemical Corp.	Box 71 Carlsbad, N. Mex. 88220	Underground mine and refinery.	Do.
Kerr-McGee Corp., Hobbs Potash Facility.	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	do	Do.
National Potash Co	Box 731 Carlsbad, N. Mex. 88220	do Underground mine	Do. Lea.
Potash Company of America, a division of Ideal Basic Industries, Inc.	Box 31 Carlsbad, N. Mex. 88220	Underground mine and refinery.	Eddy.
Southwest Potash Corp	Box 279 Carlsbad, N. Mex. 88220	do	Do.
Pumice:			
General Pumice Corp	Box 449 Santa Fe, N. Mex. 87501	Open pit mine and crushing and screening plant.	Rio Arriba.
Twin Mountain Rock Co	Box 917 Sheridan, Wyo. 82801	do	Union.
Volcanic Cinder Co	Box 9977 El Paso, Tex. 79946	do	Dona Ana.
Salt:			
New Mexico Salt Co	Box 303 Carlsbad, N. Mex. 88220	Potash tailing dump and plant.	Eddy.
The Salt Supply Co., Inc	Drawer SS Carlsbad, N. Mex. 88220	do	Do.
Sand and gravel (commercial):			
Albuquerque Gravel Products Co.	Box 1352 Albuquerque, N. Mex. 87103	Pit and stationary crushing and screening plant.	Bernalillo.
Burn Construction Co., Inc.	Box 670 Las Cruces, N. Mex. 88001	Pit and portable crushing and screening plant. do	Dona Ana. Otero.
Springer Corp	Box 572 Albuquerque, N. Mex. 87103	Pit and stationary crushing and screening plant.	Bernalillo.
Silver:			
Federal Resources Corp	1370 S. Third W. Salt Lake City, Utah 84107	*See* Copper	Hidalgo.
Kennecott Copper Corp., Chino Mines Division	Hurley, N. Mex. 88043	do	Grant.
Thomas Consolidated Mines, Inc.	637 Peyton Bldg. Spokane, Wash. 99201	Underground mine	Catron.
United States Smelting Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	*See* Copper	Grant.
Stone:			
Armstrong & Armstrong	Box 1873 Roswell, N. Mex. 88201	Quarry and plant	Eddy.
Ideal Cement Co	620 Ideal Cement Bldg. Denver, Colo. 80202	do	Bernalillo.
J. W. Jones Construction Co.	Box 8038, Station C Albuquerque, N. Mex. 87108	do do	Colfax. San Juan.
Schultz & Lindsay Construction Co.	Box 2028 Fargo, N. Dak. 58102	do	Torrance.
Uranium:			
The Anaconda Company, New Mexico Operations.	Box 638 Grants, N. Mex. 87020	Open pit mine and acid-leach process mill.	Valencia.
Kerr-McGee Corp	Box 218 Grants, N. Mex. 87020	6 underground mines and acid-leach process mill.	McKinley.
United Nuclear Corp	Box 199 Grants, N. Mex. 87020	6 underground mines Underground mine	Do. Valencia.

See footnote at end of table.

Table 18.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Uranium—Continued			
United Nuclear-Homestake Partners.	Box 98 Grants, N. Mex. 87020	9 underground mines and alkaline-leach process mill.	McKinley.
Zinc:			
The New Jersey Zinc Co	160 Front Street New York, N.Y. 10038	Open pit-underground mine, underground mine, flotation mill.	Grant.
		2 underground mines	Socorro.
United States Smelting Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	2 underground mines and flotation mill.	Grant.

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[1] Most of the major oil and gas companies and many smaller companies operate in New Mexico and several commercial directories contain complete lists of them.

The Mineral Industry of New York

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the New York State Museum and Science Service for collecting information on all minerals except fuels.

By Robert G. Clarke [1]

The value of New York's mineral production increased compared with that of 1967 and was the second highest on record, largely due to an $8 million increase in stone production. Commodities declining substantially in output and value were iron ore, petroleum, and zinc. There was a slight increase in the quantity of clays produced, but a decrease in value. There were slight increases in the output of natural gas, talc, and wollastonite. Gypsum output remained about the same as in 1967 but the value decreased. Lead, lime, and silver decreased slightly in both quantity and value. Salt decreased slightly in output but increased in value. Stone increased in both output and value. Overall construction activity remained about the same as for 1967; increases in building construction balanced decreases in highway, bridge, and related construction. The State maintained its ranking of first nationally in production of garnet, talc, and wollastonite, and continued to be a major producer of zinc, cement, gypsum, salt, sand and gravel, and stone.

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[1] Ceramic engineer, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in New York[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ---- thousand short tons--	1,506	$1,814	1,675	$1,790
Gem stones ----	NA	10	NA	10
Gypsum ---- thousand short tons--	570	3,118	570	2,925
Lead (recoverable content of ores, etc.) ---- short tons--	1,653	463	1,396	369
Lime ---- thousand short tons--	1,139	10,570	1,086	10,154
Natural gas ---- million cubic feet--	3,837	1,201	4,632	1,390
Peat ---- short tons--	23,053	232	14,888	153
Petroleum (crude) ---- thousand 42-gallon barrels--	1,972	9,026	1,532	7,098
Salt ---- thousand short tons--	5,320	41,568	5,218	42,488
Sand and gravel ---- do----	43,500	44,499	43,439	45,812
Silver (recoverable content of ores, etc.) - thousand troy ounces--	31	48	28	59
Stone ---- thousand short tons--	33,389	56,615	35,441	63,510
Zinc (recoverable content of ores, etc.) ---- short tons--	70,555	19,534	66,194	17,872
Value of items that cannot be disclosed: Abrasive garnet, cement emery, iron ore, talc, titanium concentrate, and wollastonite ----	XX	110,620	XX	106,011
Total ----	XX	299,318	XX	299,636
Total 1957–59 constant dollars ----	XX	279,875	XX	p 277,998

p Preliminary. NA. Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

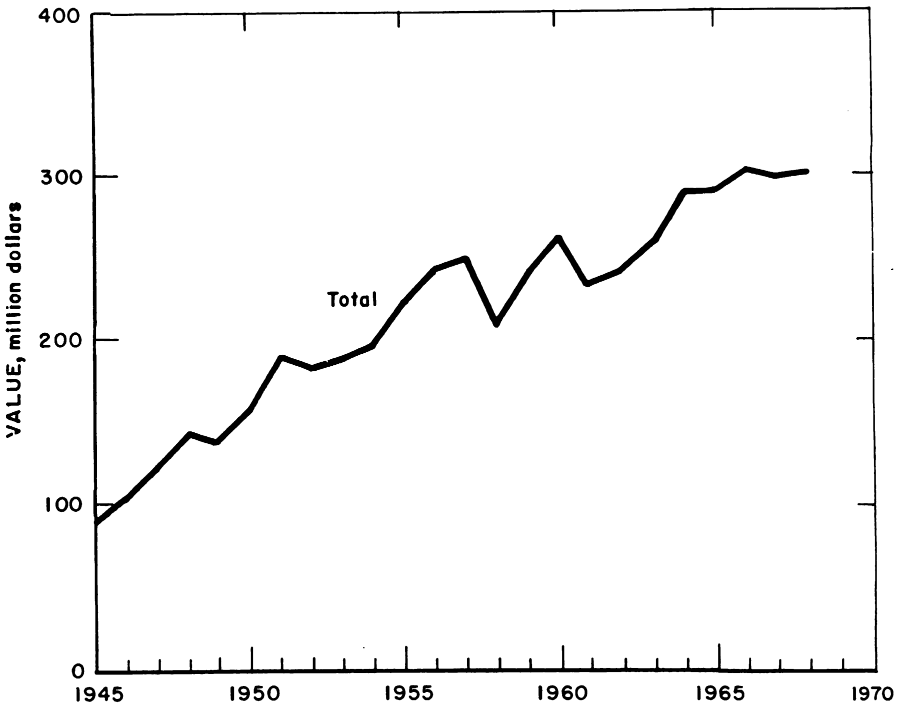

Figure 1.—Total value of mineral production in New York.

Trends and Developments.—The State's water resources continued to receive top priority in programs and studies. Cooperative programs by State agencies with the U.S. Geological Survey and the U.S. Army Corps of Engineers continued studies on water resources, drainage, and pollution abatement. Added to pollution studies in estuaries, river basins, and lake regions are studies of movements of pollutants underground which affect water supplies.

The major salt companies continued development work in underground operations and in well fields. Geophysical activity was conducted in Yates County for Morton Salt Co.

Exploratory and development work for oil and gas companies decreased considerably compared with that in 1967. Reduced opportunities for mineral extraction activities in urban areas due to zoning restrictions continued. Sand and gravel operations are experiencing land-use conflicts.

Table 2.—Value of mineral production in New York, by counties[1][2]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Albany	W	W	Cement, stone, clays, sand and gravel.
Allegany	W	W	Sand and gravel.
Broome	$1,936	$2,162	Sand and gravel, stone, clays.
Cattaraugus	1,804	2,954	Sand and gravel, peat.
Cayuga	794	W	Stone, sand and gravel.
Chautauqua	W	W	Sand and gravel.
Chemung	W	W	Do.
Chenango	W	W	Do.
Clinton	W	W	Stone, sand and gravel.
Columbia	W	W	Cement, stone, sand and gravel, clays.
Cortland	721	608	Sand and gravel.
Delaware	W	W	Stone, sand and gravel.
Dutchess	W	W	Stone, sand and gravel, clays.
Erie	14,741	13,583	Stone, cement, lime, sand and gravel, gypsum, clays.
Essex	W	W	Ilmenite, iron ore, wollastonite, sand and gravel, stone, garnet.
Franklin	W	W	Sand and gravel, stone.
Fulton	187	W	Sand and gravel.
Genesee	3,062	3,217	Stone, gypsum, sand and gravel.
Greene	18,323	18,599	Cement, stone, sand and gravel, clays.
Herkimer	W	W	Stone, sand and gravel.
Jefferson	W	W	Do.
Lewis	W	W	Do.
Livingston	W	W	Salt, sand and gravel, stone.
Madison	867	735	Stone, sand and gravel.
Monroe	4,994	5,256	Stone, sand and gravel, gypsum.
Montgomery	W	W	Stone, sand and gravel.
Nassau	3,916	4,442	Sand and gravel, clays.
Niagara	3,969	4,525	Lime, stone, sand and gravel.
Oneida	3,222	2,377	Sand and gravel, stone.
Onondaga	W	W	Salt, stone, lime, cement, sand and gravel, clays.
Ontario	1,771	1,817	Sand and gravel, stone, peat.
Orange	1,518	1,459	Do.
Orleans	W	W	Sand and gravel.
Oswego	571	536	Do.
Otsego	W	W	Sand and gravel, stone.
Putnam	W	W	Sand and gravel.
Rensselaer	1,257	1,258	Sand and gravel, stone.
Richmond	W	W	Sand and gravel.
Rockland	7,602	10,419	Stone, sand and gravel.
St. Lawrence	39,448	38,249	Zinc, iron ore, talc, stone, lead, sand and gravel, silver.
Saratoga	1,236	1,106	Stone, sand and gravel.
Schenectady	W	W	Sand and gravel.
Schoharie	W	W	Cement, stone, clays.
Schuyler	W	W	Salt, sand and gravel.
Seneca	W	W	Stone, peat.
Steuben	684	847	Sand and gravel, stone.
Suffolk	4,471	4,221	Sand and gravel.
Sullivan	W	W	Stone, sand and gravel.
Tioga	441	841	Sand and gravel.
Tompkins	W	W	Salt, stone, sand and gravel.
Ulster	17,189	17,052	Cement, stone, clays, sand and gravel.
Warren	6,504	6,394	Cement, garnet, stone, sand and gravel.
Washington	943	980	Stone, sand and gravel.
Wayne	694	658	Do.
Westchester	886	787	Stone, emery, sand and gravel, peat.
Wyoming	W	W	Salt, stone.
Yates	8	6	Sand and gravel.
Undistributed[3]	155,559	154,553	
Total[4]	299,318	299,636	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Bronx, Hamilton, Kings, New York, and Queens Counties are not listed because no production was reported.

[2] Natural gas and petroleum not listed by counties; value included with "Undistributed."

[3] Includes natural gas, petroleum, sand and gravel, and gem stones that cannot be assigned to specific counties, and values indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of New York business activity

	1967	1968	Change (percent)
Employment and labor force, annual average: Total labor force thousands	8,025	8,130	+1.3
Unemployment percent of labor force employment	3.9	3.5	−10.3
Employment:			
Construction thousands	257.2	261.9	+1.8
Durable goods do	887.4	883.0	−.5
Stone, clay, and glass products do	48.1	48.0	−.2
Primary metals do	80.0	77.0	−3.8
Fabricated metal products do	92.2	92.9	+.8
Nondurable goods do	998.2	1,002.3	+.4
Mining do	8.9	8.6	−3.4
Total nonagricultural do	6,858.3	7,011.1	+2.2
Personal income:			
Total millions	$68,916	$74,725	+8.4
Per capita	$3,824	$4,133	+8.1
Construction activity: New housing units authorized	74,351	76,634	+3.1
Cement shipments to and within New York thousand 376-pound barrels	17,604.0	17,729.8	+.7
Mineral production thousands	$299,318	$299,686	+.1

Sources: New York State Dept. of Labor: Employment Review; U.S. Dept. of Commerce: Survey of Current Business and Construction Reports.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Peat	11	188	2	17	-------	-------	-------	-------
Metal	1,565	266	417	3,334	-------	39	11.70	384
Nonmetal	2,089	252	514	4,224	-------	117	27.70	766
Sand and gravel	2,178	204	444	3,716	1	76	20.72	2,088
Stone	3,586	251	901	7,420	-------	96	12.94	579
Total [1]	9,374	243	2,278	18,711	1	328	17.58	886
1968: p								
Peat	10	202	2	16	-------	1	61.94	3,097
Metal	1,310	258	356	2,844	1	34	12.31	2,661
Nonmetal	2,190	263	576	4,660	-------	120	25.75	1,038
Sand and gravel	2,230	209	466	3,812	-------	88	23.08	519
Stone	3,365	255	859	7,066	1	109	15.57	1,701
Total [1]	9,105	246	2,259	18,399	2	352	19.24	1,438

p Preliminary.

[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasives, Manufactured.—Two producers in Niagara County operated electric furnaces for fused aluminum oxide and silicon carbide. The finished products were used in abrasives, refractories, and other nonabrasive applications.

Metallic abrasives consisting of chilled iron shot and grit, annealed iron shot and grit, and cut wire shot, were produced by two operators in Erie County.

Cement.—Shipments of all types of cement increased about 1 percent in quantity but decreased 1 percent in value compared with those of 1967. Cement however, ranked first in value among the State's mineral industries. Among the cement producing States, New York continued to rank fifth. Portland cement accounted for 98 percent of the cement value; the average price of portland cement decreased $0.06 to $2.55 per barrel. Shipments of masonry cement decreased and the average price remained at $2.21 per barrel.

Eleven plants were in operation of which nine were in eastern and two in western New York. Four plants produced portland cement exclusively and seven produced portland and masonry. Cement production was reported from eight counties; Albany County ranked first followed by Greene, Ulster, and Columbia Counties.

Cement rock and limestone comprising 7.6 million tons were the principal raw materials for manufacturing portland cement. Other raw materials included clay and shale (440,000 tons), gypsum (233,000 tons), sand (31,000 tons), and iron-bearing materials (20,000 tons). Grinding aids, air-entraining compounds, bauxite, and other materials were also used. A total of 686 million kilowatt-hours of electrical energy were consumed, all of which were purchased by cement plants. The Universal-Atlas Cement Co. increased the capacity of its Hudson, Columbia County, plant to 4 million barrels by installing a new rotary kiln.

Forty-one percent of the combined portland and masonry cement shipped was consumed within the State; 35 percent was shipped to New England; and 7 percent was shipped to Florida. More than 12,000 barrels of New York cement was exported.

Ready-mixed concrete companies purchased 61 percent of the portland cement shipped. Other large customers included concrete product manufacturers, building material dealers, and highway and other contractors. Cement was shipped by truck (73 percent), railroad (15 percent), and boat (12 percent). Bulk shipments were 95 percent of the total; the balance was shipped in packaged containers.

Most of the portland cement produced was the non-air-entrained, general-use type, although over 2 million barrels of air-entrained, general-use type and 1 million barrels of high-early-strength portland cement were produced. Wet process plants accounted for about three-fourths of the output. Yearend stocks of portland cement were 8 percent more than in 1967.

The following quarry operations of cement producers received citations from the National Safety Competition for having had no disabling injuries during 1968: Alsen Quarry, Lehigh Portland Cement Co., Cementon, Greene County; Catskill Quarry, Marquette Cement Manufacturing Co., Catskill, Greene County; and Howes Cave 6H Quarry, Penn-Dixie Cement Corp., Howes Cave, Schoharie County.

Clays.—Overall clay production increased 11 percent over 1967 quantities due to increased output for lightweight aggregate in Ulster County and portland cement in other counties. Building brick usage declined by 3 percent. Special clays for pottery and abrasive bonding amounted to about the same as 1967 output, and altogether accounted for less than 0.5 percent of the total clays produced. Leading counties, in decreasing order of tonnage of clay and shale produced, were Ulster and Albany in the east and Erie in the west.

Emery.—Production for the entire United States was reduced to two open-pit mines in Westchester County. Output and value decreased compared with 1967 levels. Uses included general abrasive purposes and as aggregate for heavy-duty nonslip floors and pavements.

Garnet.—Output increased by small percentages in quantity and value compared with 1967 levels. Garnet from an open-pit mine in Warren County was sold for precision uses in coated abrasives, glass grinding and polishing, and metal lapping. Garnet recovered as a byproduct of wollastonite mining in Essex County was sold for use in sandblasting.

Gem Stones.—Amateur mineral collectors were the principal gatherers of gem stones and mineral specimens except for the commercial garnet produced.

Graphite (Manufactured).—Manufactured graphite from petroleum coke and other materials was produced at Niagara Falls, Niagara County, and in Queens County by divisions of various corporations. Principal uses were for anodes, electrodes, electric motor brushes, crucibles, and other refractories.

Gypsum.—The quantity of crude gypsum produced was approximately the same as in 1967 and the total value was 6 percent less. The average price per ton decreased $0.34 to $5.13. Output came from five underground mines, three in Erie County and one each in Genesee and Monroe Counties. Most of the crude gypsum was calcined at company-owned plants for use in manufacturing building materials. Seven calcining plants, located in Bronx, Erie (2), Genesee, Monroe, Richmond, and Rockland Counties were in operation. Uses for calcined gypsum other than in building materials included manufacturing plate glass, pottery, molding, and art and coating plasters. Some crude gypsum was used as a retarder in portland cement.

Table 5.—Crude gypsum production

(Thousand short tons and thousand dollars)

Year	Active mines	Quantity	Value
1964	5	653	$3,321
1965	5	662	3,511
1966	5	559	2,998
1967	5	570	3,118
1968	5	570	2,925

Lime.—Production of lime in Erie, Niagara, and Onondaga Counties decreased about 5 percent and the value decreased 4 percent compared with 1967 levels. The lime plant of the Bethlehem Steel Corp. in Erie County was operated to supply quicklime for the basic oxygen furnaces at Lackawanna. All other quicklime was captive production by chemical companies. Quicklime accounted for about 90 percent of the lime output. Most hydrated lime was used for chemical processing; some was used for construction. Among the lime-producing States, New York ranked sixth in quantity and ninth in value.

Perlite.—Crude perlite mined in Western States was expanded at seven plants, three in Erie County, and one each in Bronx, Genessee, Richmond, and Rockland Counties. The most important use was in acoustical building plaster. Other uses included loose fill insulation, soil conditioning, lightweight concrete aggregate, and filtering.

Salt.—Production of salt decreased 2 percent in quantity compared with that of 1967 but the value increased 2 percent. The greater relative increase in value was mainly because of increases in value per ton for evaporated and rock salt whereas brine remained constant. There was slightly less output of salt for each type of production. Based on tonnage, most evaporated salt was used for food processing and seasoning. Another large use for evaporated salt was for manufacturing chlorine and other chemicals. The principal use for rock salt was for ice control on highways in the Northeastern States. Other important uses for rock salt were the chemical and food industries. Salt in brine was used mainly for the manufacture of soda ash; some salt in brine was used for the manufacture of chlorine and other chemicals. Salt for chemical manufacture was used mainly in New York. Rock salt was mined in Livingston and Tompkins Counties, and salt was produced from wells in Onondaga, Schuyler, and Wyoming Counties. The State ranked fourth in production and fourth in value among the salt-producing States.

Table 6.—Salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	4,816	$34,216
1965	5,002	35,771
1966	4,980	36,203
1967	5,320	41,568
1968	5,218	42,488

In 1968, geophysical contractors completed 6 crew-weeks of seismic-reflection work in Milo Township, Yates County, for salt.

Sand and Gravel.—Production of sand and gravel decreased by less than 0.5 percent compared with that of 1967. The average price increased by $0.03 to $1.05 per ton. There were 273 commercial operations and many other locations operated by construction companies and government operators working on various Federal, State, county, and local government contracts. Three operations had production in excess of 1 million tons and 5 had production between 500,000 and 1 million tons. Production from these eight large operators comprised 29 percent of the commercial output. There were 108 small pits in operation, each producing less than 25,000 tons, which accounted for 4 percent of the total commercial output. Bank-run (unprocessed) sand and gravel amounted to 21 percent of the total output. More than 1 million tons each was reported from Suffolk, Nassau, Cattaraugus, Broome, Dutchess, Monroe, Erie, Oneida, and Ontario Counties in decreasing order of tonnage.

Table 7.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	9,960	$11,823	9,630	$12,211
Paving	3,260	4,189	3,216	4,326
Fill	1,406	746	1,113	439
Molding	W	W	145	707
Filtration	W	W	42	63
Other	524	482	684	701
Undistributed [1]	245	885	39	87
Total	15,395	18,125	14,869	18,534
Gravel:				
Building	4,969	7,395	4,693	7,166
Paving	4,217	4,804	4,531	5,234
Fill	2,704	1,656	2,541	1,545
Undistributed [2]	643	508	793	863
Total	12,533	14,363	12,558	14,808
Total sand and gravel	27,928	32,488	27,427	33,342
Government-and-contractor operations: [3]				
Sand:				
Building	94	141	98	146
Paving	626	440	690	474
Fill	2,975	1,238	3,070	1,280
Other	637	320	692	333
Total	4,332	2,139	4,550	2,233
Gravel:				
Paving	6,483	6,885	6,552	7,143
Fill	4,636	2,936	4,853	3,072
Other	121	51	57	22
Total	11,240	9,872	11,462	10,237
Total sand and gravel	15,572	12,011	16,012	[4] 12,469
All operations:				
Sand	19,727	20,264	19,419	20,767
Gravel	23,773	24,235	24,020	25,045
Total	43,500	44,499	43,439	45,812

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes engine sand, foundry sand (1968), and other sand.
[2] Includes railroad ballast and other gravel.
[3] Includes data for State, counties, municipalities, and other government agencies.
[4] Data do not add to totals shown because of independent rounding.

Stone.—Total stone production increased 6 percent in quantity and 12 percent in value over that of 1967. Stone was the second most valuable mineral commodity produced in the State. The increase in production, both quantity and value, was all in the combined limestone and dolomite sector. Dutchess County ranked first in value among the State's 40 stone-producing counties, followed by Rockland, Onondaga, and Erie. Fourteen counties had stone industries with output valued in excess of $1 million. Crushed limestone and dolomite, considered together as carbonate rock, was the predominant type in the State, accounting for 91 percent of the tonnage and 83 percent of the value of all stone produced. Limestone and dolomite was mined in 32 counties, of which 10 reported output exceeding 1 million tons each. The chief uses for crushed dolomite and limestone were as an aggregate material and for the manufacture of cement and lime. Other uses were agricultural stone, riprap, railroad ballast, asphalt filler, fluxing stone, and whiting. A small quantity of dimension

Table 8.—Sand and gravel production by Government-and-contractor operations, by counties

(Thousand short tons)

County	1967	1968	County	1967	1968
Allegany	29	31	Niagara	------	4
Broome	98	175	Oneida	257	149
Cattaraugus	104	81	Onondaga	278	185
Cayuga	25	14	Ontario	32	48
Chatauqua	265	244	Orange	56	98
Chemung	26	82	Orleans	3	8
Chenango	97	68	Oswego	100	80
Clinton	16	34	Otsego	52	62
Columbia	17	7	St. Lawrence	100	161
Cortland	20	20	Saratoga	36	51
Delaware	19	14	Schenectady	7	------
Dutchess	78	------	Schoharie	3	------
Essex	8	33	Schuyler	28	27
Franklin	93	123	Steuben	151	148
Fulton	------	24	Suffolk	9	17
Genessee	27	34	Sullivan	5	5
Herkimer	66	33	Tioga	3	1
Jefferson	268	250	Washington	26	21
Lewis	96	80	Wayne	119	119
Livingston	3	9	Yates	22	18
Montgomery	9	13	Undistributed [1]	12,921	13,501
			Total	15,572	16,012

[1] Includes data unspecified by counties.

limestone was produced in Niagara and Onondaga Counties.

The following limestone quarries received citations from the National Safety Competition for having had no disabling work injuries during 1968: Stafford Quarry, Genesee Stone Products Corp., Genesee County; and Oriskany Falls Quarry, Eastern Rock Products, Inc., Oneida County.

Basalt (traprock) ranked second among stone and was produced only in Rockland County. Compared with that of 1967, output decreased 10 percent. The chief uses were for concrete aggregate and road metal.

Sandstone and quartzite were quarried and marketed as dimension stone and as crushed stone. Sandstone ranked third in tonnage and value in the State. The quantity produced decreased 12 percent but value increased 11 percent. Production was reported from eight counties, led by Delaware and Sullivan.

Marble, quarried in St. Lawrence County, was crushed and ground for a variety of uses, mostly for road metal and agriculture.

Slate was quarried and prepared for use as flagstone, roofing, structural, and sanitation stone in Washington County. Tonnage of slate output was 14 percent less than in 1967 and value decreased 10 percent. Granite was quarried and dressed in Essex and Westchester Counties for building stone. Crushed granite from Warren and Westchester Counties was used for concrete aggregate and roadstone. Dimension stone granite decreased in volume but increased in value compared with 1967. Crushed granite decreased in both volume and value. Miscellaneous stone reported from Rensselaer and Clinton Counties, decreased 26 percent in tonnage and 16 percent in value; it was used for concrete aggregate and roadstone.

Table 9.—Crushed and broken limestone and dolomite sold or used by producers by uses

(Thousand short tons and thousand dollars)

Use	1967		1968	
	Quantity	Value	Quantity	Value
Riprap	264	$525	167	$337
Aggregates [1]	19,895	35,804	22,054	41,461
Agricultural	371	1,376	357	1,043
Railroad ballast	244	383	W	W
Cement	6,890	6,141	6,476	5,572
Miscellaneous uses, including fluxing stone and lime	1,951	2,597	3,146	4,596
Total	29,615	46,826	32,200	53,009

W Withheld to avoid disclosing individual company confidential data.

[1] Includes concrete, bituminous, macadam, surface treatment aggregates, and dense graded road base stone.

Talc.—The quantity and value of talc mined was greater than in 1967. New York continued to be the leading talc-producing State. Two companies mined talc from two underground mines and one open cut mine in St. Lawrence County. One underground mine in St. Lawrence County has been closed. Crude talc was ground in company-owned mills and marketed principally for use in ceramics and as a mineral filler in paints. Small quantities were used as a mineral filler in floor and wall tiles, rubber, and miscellaneous products.

Vermiculite.—Crude vermiculite mined in other States was exfoliated at a plant in Weedsport, Cayuga County. The expanded vermiculite was used for loose fill insulation, agriculture, ultralightweight concrete aggregate, and building plaster aggregate.

Wollastonite.—Crude wollastonite was mined and beneficiated at the Willsboro Mine in Essex County by the Oxides Division, Cabot Corp. The refined wollastonite was used as a filler in paints and plastics and as an ingredient in ceramic products.

METALS

Aluminum.—Production of primary aluminum from the Massena plants, St. Lawrence County, of Aluminum Company of America and Reynolds Metals Co. decreased in both tonnage and value compared with that of 1967. The State ranked sixth in aluminum production.

Iron Ore.—Mine production of magnetite iron ore decreased 5 percent from an underground mine in Essex County and two open-pit mines, one each in Essex and St. Lawrence Counties. Production of concentrates decreased, but mill concentrate stocks increased. All of the ore was beneficiated and most of the concentrates were agglomerated before shipment. Principal uses for shipments were in the manufacture of pig iron and steel and some in the manufacture of cement, for heavy media separation, and for ballast.

Old Bed, Harmony Mine, Republic Steel Corp., Port Henry, Essex County, received an outstanding safety award for 1968 in the National Safety Competition.

Lead.—Lead was recovered as a byproduct of zinc mining at the Balmat mine in St. Lawrence County. Quantity and value decreased 16 percent and 20 percent, respectively, compared with 1967 levels. Lead recovery varies from year to year, depending on the proportion of ore coming from that section of the Balmat mine where the vein has a higher lead content. The lead concentrate was shipped to the company's lead smelter at Herculaneum, Mo.

Silver.—The quantity of silver recovered from lead concentrates shipped from the Balmat mine in St. Lawrence County was 10 percent less than that of 1967 but the value increased 23 percent. Silver recovery usually reflects the demand for silver-free lead rather than the silver content of the concentrate. The average value of silver rose from $1.55 per ounce in 1967 to $2.11 per ounce in 1968.

Titanium Concentrate (Ilmenite).—Ilmenite concentrate was recovered as a coproduct of magnetite from an open cut titaniferous-magnetite deposit near Tahawus, Essex County. Shipments and value were 6 percent greater than those of 1967. The output was used principally in the manufacture of titanium dioxide pigment.

Zinc.—New York continued to rank second to Tennessee in U.S. zinc production. Production, all from the Balmat and

Table 10.—Mine production of silver, lead, and zinc, in terms of recoverable metals

Year	Mines producing	Material sold or treated (short tons)	Silver		Lead		Zinc		Total value (thousands)
			Troy ounces	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1964	2	683,494	13,306	$17	732	$192	60,754	$16,525	$16,734
1965	2	788,961	11,441	15	601	188	69,880	20,405	[1] 20,607
1966	2	818,408	21,590	28	1,097	332	73,454	21,302	[1] 21,661
1967	2	808,749	31,103	48	1,653	468	70,555	19,534	20,045
1968	2	785,109	27,615	59	1,396	369	66,194	17,872	18,300

[1] Data do not add to total shown due to independent rounding.

Edwards mines in St. Lawrence County, decreased 6 percent in volume and 9 percent in value. St. Joseph Lead Co. reported satisfactory progress in sinking No. 4 shaft at Balmat. The 18-foot-diameter circular shaft reached a depth of 2,400 feet in 1968.

Table 11.—Mine production of silver, lead, and zinc, in 1968, by months, in terms of recoverable metals

Month	Silver (troy ounces)	Lead (short tons)	Zinc (short tons)
January	2,933	142	6,283
February	2,750	137	5,776
March	2,584	127	6,438
April	2,609	121	5,355
May	2,290	105	5,646
June	2,460	114	5,356
July	2,315	108	5,094
August	2,070	99	5,486
September	1,497	70	4,945
October	1,734	112	5,216
November	1,714	135	5,454
December	2,659	126	5,145
Total	27,615	1,396	66,194

MINERAL FUELS

Natural Gas.—According to the Geological Survey, New York State Museum and Science Service, the production of natural gas increased 21 percent to 4.6 billion cubic feet. Estimated crude recoverable reserves of natural gas at yearend, according to the American Gas Association, were 124 billion cubic feet, of which 96 billion cubic feet was in underground storage reservoirs. Reserves were 2 percent greater than at yearend 1967. Natural gas was stored underground in eight counties by five companies; rated capacity was 101.8 billion cubic feet ultimate.[2] The Oil and Gas Journal[3] reported that Mobil Oil Corp. had capacity to store 669,000 barrels of liquefied petroleum gas (propane, 455,000 barrels; butane, 214,000 barrels) in Steuben County; Suburban Propane Gas Corp. had capacity to store 400,000 barrels of propane in Cortland County; Texas Eastern Transmission Corp. had capacity to store 3 million barrels of propane in Schuyler County. These storage facilities were in underground cavities mined in salt. In addition, Texas Eastern Transmission Corp. had inground refrigerated storage capacity for 600,000 barrels of liquid natural gas in Richmond County (Staten Island). Brooklyn Union Gas Co. had capacity for storing 175,000 barrels of liquid natural gas above ground in Kings County (Brooklyn).

Table 12.—Marketed production of natural gas

(Million cubic feet and thousand dollars)

Year	Quantity	Value	Average value (cents per thousand cubic feet)
1964	3,108	$963	31.0
1965	3,340	1,029	30.8
1966	2,699	837	31.0
1967	3,837	1,201	31.3
1968	4,632	1,390	30.0

Peat.—Sales of peat decreased 35 percent in quantity and 34 percent in value from those in 1967. The value per ton increased to $10.27. Peat use was mainly in general soil improvement, although some peat was used for flowers and plants, etc. Orange County was the leading producing area; output was also reported from Cattaraugus, Westchester, and Seneca Counties. Bulk shipments accounted for only 41 percent of production.

Petroleum.—Production of crude oil decreased 22 percent from that of 1967. Wells in the Cattaraugus field, Cattaraugus County, yielded 65 percent of the total; the remainder came from the Allegany field in Allegany, and the Busti pool in Chautauqua County. Average prices for crude oil at the well head were $4.63 per barrel in Cattaraugus County, and ranged from $4.35 to $4.51 in other areas. Proved reserves of crude oil at yearend were 13.0 million barrels according to estimates of the American Petroleum Institute.

Table 13.—Petroleum production

(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value	Average value per barrel
1964	1,874	$8,321	$4.44
1965	1,632	7,246	4.44
1966	1,735	7,925	4.57
1967	1,972	9,026	4.58
1968	1,532	7,093	4.63

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[2] Oil and Gas Journal. V. 66, No. 22, May 27, 1968, p. 136.

[3] Oil and Gas Journal. V. 66, No. 43, Oct. 21, 1968, pp. 105–106.

Table 14.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1968

County	Drilling								Geophysical crew-weeks: Reflection seismograph method
	Proved field wells			Exploratory wells			Total		
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage	
Allegany	27	----	----	----	1	----	28	42,750	-------
Cattaraugus	31	----	1	----	----	2	34	44,672	-------
Cayuga	----	4	----	----	----	1	5	11,092	-------
Chatauqua	25	1	1	----	----	2	29	26,999	-------
Chenango	----	----	----	----	----	1	1	6,292	-------
Erie	----	2	1	----	----	----	3	3,933	-------
Genesee	----	2	----	----	----	----	2	3,092	-------
Ontario	----	----	----	----	----	1	1	6,000	-------
Steuben	----	----	2	----	----	1	3	14,390	1
Total	83	9	5	----	1	8	106	159,220	1

Source: American Association of Petroleum Geologists.

Table 15.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Artificial:			
The Carborundum Co., Electro Mineral Div.	P.O. Box 423 Niagara Falls, N.Y. 14300	Plant	Niagara.
General Abrasives Co., Inc.	Niagara Falls, N.Y. 14300	do	Do.
Metallic:			
Cleveland Metal Abrasives Co., Div. of Fanner Mfg. Co.	Brookside Park Cleveland, Ohio 44109	do	Erie.
Pellets, Inc	533 S. Niagara St. Tonawanda, N.Y. 14150	do	Do.
Cement:			
Alpha Portland Cement Co.[2]	15 South 3d St. Easton, Pa. 18043	do	Greene.
Alpha Portland Cement Co	----	do	Onondaga.
Atlantic Cement Co., Inc.[1]	P.O. Box 3 Ravena, N.Y. 12143	do	Albany.
Century Cement Mfg. Co., Inc.	Rosendale, N.Y. 12472	do	Ulster.
Glens Falls Portland Cement Co.[2] Division of Flintkote Co.	313 Warren St. Glens Falls, N.Y. 12801	do	Warren.
Hudson Cement Division [2] Colonial Sand & Stone Co., Inc.	1740 Broadway New York, N.Y. 10019	do	Ulster.
Lehigh Portland Cement Co.	718 Hamilton St. Allentown, Pa. 18105	do	Erie.
Lehigh Portland Cement Co.[2]	----	do	Greene.
Marquette Cement Mfg. Co.[3]	20 N. Wacker Dr. Chicago, Ill. 60606	do	Do.
Penn Dixie Cement Corp.[1]	P.O. Box 152 Nazareth, Pa. 18064	do	Schoharie.
Universal Atlas Cement Division [1] U.S. Steel Corp.	Chatham Center Pittsburgh, Pa. 15230	do	Columbia.
Clays (miscellaneous):			
Beacon Brick Corp	P.O. Box 407 Beacon, N.Y. 12508	Pit	Dutchess.
Binghamton Brick Co., Inc	P.O. Box 1216 Binghamton, N.Y. 13902	Pit	Broome.
Hudson Lightweight Stone Div. Colonial Sand & Stone Co., Inc.	1740 Broadway New York, N.Y. 10019	Pit	Ulster.
Hudson Valley Lightweight Aggregate Corp.	P.O. Box 9138 Richmond, Va. 23227	Pit	Do.
Jova Brick Mfg. Corp	Kingston, N.Y. 12401	Pit	Do.
Nassau Brick Co., Inc	P.O. Box 160 Farmingdale, L.I., N.Y. 11735	Pit	Nassau.

See footnotes at end of table.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays (miscellaneous)—Continued			
Nytralite Aggregate, Inc., Div. New York Trap Rock Corp.	162 Old Mill Rd. West Nyack, N.Y. 10994	Pit	Ulster.
Powell & Minnock Brick Works, Inc.	Coeymans, N.Y. 12046	Pit	Albany.
Emery:			
De Luca Emery Mine, Inc	926 Constant Ave. Peekskill, N.Y. 10566	Pit	Westchester.
Di Rubbo American Emery Ore.	Locust Ave. Peekskill, N.Y. 10566	Pit	Do.
Garnet: Barton Mines Corp	North Creek, N.Y. 12853	Pit	Warren.
Graphite (synthetic):			
The Carborundum Co., Graphite Products Div.	2050 Cory Dr. Sanborn, N.Y. 14132	Plant	Niagara.
Great Lakes Carbon Corp., Graphite Products Div.	299 Park Ave. New York, N.Y. 10017	do	Do.
Space Age Materials Corp	285 East 42d St. New York, N.Y. 10017	do	Queens.
Speer Carbon Co., International Graphite & Electrode Division.	Packard Rd. Niagara Falls, N.Y. 14302	do	Niagara.
Union Carbide Corp., Carbon Products Div.	270 Park Ave. New York, N.Y. 10017	Plant	Niagara.
Gypsum:			
Crude:			
GAF Corporation,[4] Bldg., Indust. & Floor Prod. Div.	140 West 51st Street New York, N.Y. 10020	Underground	Monroe.
Georgia-Pacific Corp.[5] Bestwall Gypsum Div.	Commonwealth Bldg. Portland, Oreg. 97207	do	Erie.
National Gypsum Co.[5]	325 Delaware Ave. Buffalo, N.Y. 14202	do	Do.
United States Gypsum Co.[5]	101 S. Wacker Dr. Chicago, Ill. 60606	do	Genesee.
Universal Atlas Cement Div. U.S. Steel Corp.	Chatham Center Pittsburgh, Pa. 15230	do	Erie.
Calcined:			
National Gypsum Co.[6]	325 Delaware Ave. Buffalo, N.Y. 14202	Plant	Bronx.
United States Gypsum Co.[6]	101 S. Wacker Dr. Chicago, Ill. 60606	do	Richmond and Rockland.
Iron ore:			
Jones & Laughlin Steel Corp	Star Lake, N.Y. 13690	Pit	St. Lawrence.
Republic Steel Corp	1629 Republic Bldg. Cleveland, Ohio 44101	Underground	Essex.
Lime:			
Bethlehem Steel Corp	701 E. 3d St. Bethlehem, Pa. 18016	Plant	Erie.
Industrial Chemicals Div. Allied Chemical Corp.	P.O. Box 70 Morristown, N.J. 07960	do	Onondaga.
Lime (regenerated):			
International Paper Co	220 East 42d St. New York, N.Y. 10017	Plant	Essex.
Do	North Tonawanda, N.Y. 14120	do	Niagara.
Natural gas:			
Consolidated Gas Supply	Two Gateway Center Pittsburgh, Pa. 15222	Well	Allegany, Chemung, Livingston, Madison.
Felmont Oil Corp	701 Hooker-Fulton Bldg. Bradford, Pa. 16701	do	Cattaraugus.
Iroquois Gas Corp	10 Lafayette Square Buffalo, N.Y. 14221	do	Cattaraugus, Chautauqua, Erie.
Reserve Gas Corp		do	Erie and Genesee.
Peat:			
Finger Lakes Peat Moss Co	R.D. 2 Phelps, N.Y. 14532	Bog	Seneca.
Sterling Forest Peat Co., Inc	P.O. Box 608 Tuxedo, N.Y. 10987	Bog	Orange.
Stone Age Humus Corp	Armonk, N.Y. 10504	Bog	Westchester.
Sue Peat Co	Allegany, N.Y. 14706	Bog	Cattaraugus.
Perlite (expanded): Buffalo Perlite Corp.	100 Sugg Rd. Buffalo, N.Y. 14225	Plant	Erie.

See footnotes at end of table.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Petroleum:			
Crude:			
Bradley Producing Corp.	313 N. Main St. Wellsville, N.Y. 14895	Well	Various.
DYM Oil Corp	Box 550 Olean, N.Y. 14760	do	Allegany.
Ebenezer Oil Co	85 N. Main St. Wellsville, N.Y. 14895	do	Various.
Kendall Refining Co., Div. of Witco Chemical Co	77 N. Kendall Ave. Bradford, Pa. 16701	do	Do.
Pennzoil Co., Pennzoil United.	900 Southwest Tower Houston, Texas 77034	do	Cattaraugus.
Richardson Petroleum Corp.	Box 109 Wellsville, N.Y. 14895	do	Various.
Vosburg Oil Co		do	Do.
Refineries:			
Mobil Oil Co	Buffalo, N.Y. 14221	Plant	Erie.
Frontier Oil Refining Corp, Div. Ashland Oil & Refining Co.	Tonawanda, N.Y. 14150	do	Do.
Salt:			
Evaporated:			
International Salt Co	Clarks Summit, Pa. 18411	Well	Schuyler.
Morton Salt Co	110 N. Wacker Dr. Chicago, Ill. 60606	do	Wyoming.
The Watkins Salt Co., Inc.[7]	Box 150 Watkins Glen, N.Y. 14891	do	Schuyler.
Rock:			
Cayuga Rock Salt Co., Inc.	191 Portland Pt. Rd. Myers, N.Y. 14866	Underground	Tompkins.
International Salt Co	Clarks Summit, Pa. 18411	do	Livingston.
Brine: Industrial Chemicals Div.[8] Allied Chemical Corp.	P.O. Box 70 Morristown, N.J. 07960	Well	Onondaga.
Sand and gravel:			
Barney & Dickenson, Inc	R.D. 1 Vestal, N.Y. 13850	Pit	Broome.
Colonial Sand & Stone Co., Inc.	1740 Broadway New York, N.Y. 10019	Pit	Nassau.
Country Side Sand & Gravel, Inc.	South Dayton, N.Y. 14138	Pit	Cattaraugus.
Dolomite Products Co., Inc.	1150 Penfield Rd. Rochester, N.Y. 14625	Pit	Monroe.
Elmira Transit Mix, Inc	Box 231 Easton, Pa. 18042	Pit	Chemung.
Bob Murphy, Inc	Vestal, N.Y. 13850	Pit	Broome.
Penn Industries, Inc	136 East 57th St. New York, N.Y. 10022	Pit	Nassau.
Pine Hill Concrete Mix Corp.	2255 Bailey Ave. Buffalo, N.Y. 14200	Pit	Erie.
Roanoke-Mabro Sand & Gravel Corp.	P.O. Box 172 Riverhead, L.I., N.Y. 11901	Pit	Suffolk.
Steers Sand & Gravel Corp	17 Battery Place New York, N.Y. 10004	Pit	Do.
West Hills Silica Sand Mining Corp.	P.O. Box 722 Melville, N.Y. 11746	Pit	Do.
Smelters (aluminum):			
Aluminum Company of America.	1501 Alcoa Bldg. Pittsburgh, Pa. 15222	Plant	St. Lawrence.
Reynolds Metals Co	6601 Broad Street Rd. Richmond, Va. 23215	do	Do.
Stone:			
Basalt (crushed):			
Appalachian Stone Div.[2] Martin Marietta Corp.	18 New Hempstead Rd. New City, N.Y. 10956	Quarry	Rockland.
New York Trap Rock Corp.	162 Old Mill Rd. W. Nyack, N.Y. 10994	do	Do.
Rockland Materials Corp.	P.O. Box 57 Suffern, N.Y. 10901	do	Do.
Granite (dimension):			
Di Rienzo Brothers	107 Main St. Tuckahoe, N.Y. 10700	do	Westchester.
Frank Baratta, P. D'Amato & Angelo Cucchiella, T/A Dunwoodie Stone Quarry, Inc.	941 Midland Ave. Yonkers, N.Y. 10700	do	Do.
Lake Placid Granite Co.	St. Cloud, Minn. 56301	do	Essex.
Lake Street Granite Quarry, Inc.[9]	Lake Street E. White Plains, N.Y. 10600	do	Westchester.

See footnotes at end of table.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Granite (crushed): Northern Materials, Inc.	Rte. 9 Chestertown, N.Y. 12817	Quarry	Warren.
Limestone (dimension):			
Brickyard Falls Farm [9]	R.D. 2 Manlius, N.Y. 13104	do	Onondaga.
Frontier Stone Products, Inc.	Box 376 Lockport, N.Y. 14094	do	Niagara.
Limestone and dolomite (crushed):			
Appalachian Stone Div. Martin Marietta Corp.	18 New Hempstead Road New City, N.Y. 10956	do	Rockland.
Buffalo Crushed Stone Co.	10 Park Place Morristown, N.J. 07960	do	Erie.
The Buffalo Slag Co., Inc. Federal Crushed Stone Div.	111 Great Arrow Ave. Buffalo, N.Y. 14216	do	Do.
The Callanan Road Improvement Co.	South Bethlehem N.Y. 12161	do	Albany and Ulster.
Dolomite Products Co.[10]	1150 Penfield Rd. Rochester, N.Y. 14625	do	Monroe.
Eastern Rock Products, Inc. [10]	404 Court St. Utica, N.Y. 13504	do	Oneida.
The General Crushed Stone Co.	712 Drake Bldg. Easton, Pa. 18042	do	Onondaga.
Industrial Chemicals Div. Allied Chemical Corp.	P.O. Box 70 Morristown, N.J. 07960	do	Do.
Niagara Stone Div. of Great Lakes Color Printing Corp.	Quarry Road Niagara Falls, N.Y. 14304	do	Niagara.
Marble (crushed):			
Balducci Crushed Stone Co	Box 158 Gouverneur, N.Y. 13642	do	St. Lawrence.
Universal Marble Products Corp.	Thornwood, N.Y. 10594	do	Westchester.
Miscellaneous (crushed): Fitzgerald Bros. Construction Co., Inc.	504 Broadway Troy, N.Y. 12180	do	Rensselaer.
Sandstone (dimension):			
Adirondak Stone Quarries, Inc.[11]	P.O. Box 184 Malone, N.Y. 12953	do	Franklin.
American Blue Stone Co.	Portageville, N.Y. 14536	do	Wyoming.
Downsville Stone Co.[12]	1 Dock St. Stamford, Conn. 06902	Processor	Delaware.
Finger Lakes Stone Co., Inc.	Box 401 Ithaca, N.Y. 14850	Quarry	Tompkins.
Willis Hankins	Hancock, N.Y. 13783	do	Delaware.
Johnston & Rhodes Bluestone Co.	East Branch, N.Y. 13756	do	Do.
W. R. Strong & Son	43 Wheeler St. Deposit, N.Y. 13754	Processor	Do.
Paul Tompkins Estate	Hancock, N.Y. 13783	do	Do.
Sandstone (crushed):			
Corbisello Quarries	Ingraham Hill Rd. Binghamton, N.Y. 13900	Quarry	Broome.
Steuben Crushed Stone Co.	County Route #10 Bath, N.Y. 14810	do	Steuben.
Sullivan Highway Products Corp.	P.O. Box 392 Monticello, N.Y. 12701	do	Sullivan.
Slate (dimension):			
Darius Slate Products	Middle Granville, N.Y. 12849	do	Washington.
A. A. Hadeka Quarry	49 South St. Poultney, Vt. 05764	do	Do.
McCullen Slate Co	R.D. 1 Granville, N.Y. 12832	do	Do.
The A. B. Potter Slate Co., Inc.	Poultney, Vt. 05764	do	Do.
Ritchie Brothers Slate Co.	Middle Granville, N.Y. 12849	do	Do.
Sheldon Slate Products Co.		do	Do.
Vermont Structural Slate Co., Inc.	Prospect St. Fair Haven, Vt. 05743	do	Do.
Western Slate Co	Box 104 Granville, N.Y. 12832	do	Do.
Williams Bros. Slate Co.	Middle Granville, N.Y. 12849	do	Do.

See footnotes at end of table.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Talc:			
Gouverneur Talc Co., Inc	Gouverneur, N.Y. 13642	Underground	St. Lawrence.
International Talc Co., Inc	420 Lexington Ave. New York, N.Y. 10006	do	Do.
Titanium concentrate: Ilmenite: National Lead Co.[13]	111 Broadway New York, N.Y. 10006	Pit	Essex.
Vermiculite (exfoliated): Zonolite Division W. R. Grace Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Plant	Cayuga.
Wollastonite: Cabot Corp.,[14] Oxides Div.	Willsboro, N.Y. 12996	Underground	Essex.
Zinc: St. Joseph Lead Co.[15]	250 Park Ave. New York, N.Y. 10017	do	St. Lawrence.

[1] Also crushed limestone and shale. [2] Also crushed limestone. [3] Also crushed limestone and clay. [4] Also calcined gypsum. [5] Also calcined gypsum and expanded perlite. [6] Also expaneded perlite. [7] Also brine. [8] Also evaporated salt and crushed limestone. [9] Also crushed. [10] Also sand and gravel. [11] Quartzite. [12] c/o MSR, Inc. [13] Also iron ore. [14] Also garnet. [15] Also lead and silver.

The Mineral Industry of North Carolina

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of North Carolina for collecting information on all minerals except fuels.

By V. A. Danielson[1] and Stephen G. Conrad[2]

Mineral production in North Carolina was valued at $83 million in 1968, an increase of $6 million, or 7 percent over that of 1967. Stone was the leading mineral commodity produced, contributing 51 percent of the total value. Other mineral commodities mined, in order of value, were sand and gravel, phosphate rock, feldspar, lithium minerals, mica, clays, and talc and pyrophyllite. Leading mineral producers were Superior Stone Co., Ideal Cement Co., Vulcan Materials Co., and Texas Gulf Sulphur Co.

North Carolina ranked first among the States in production of feldspar, mica, and lithium minerals, and second in olivine.

Most of the important economic indicators showed significant gains in 1968. Indicators with the greatest increases were factory payrolls, personal income, value of building permits, consumption of electric energy, and import and export trade.

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[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.

[2] State geologist, North Carolina Department of Conservation and Development, Division of Mineral Resources, Raleigh, N.C.

Table 1.—Mineral production in North Carolina[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite short tons	500	$6	W	W
Clays[2] thousand short tons	2,977	2,012	3,310	$2,148
Feldspar long tons	265,690	3,113	316,862	4,340
Gem stones	NA	25	NA	20
Mica:				
Scrap short tons	69,639	1,751	69,054	1,640
Sheet pounds	4,500	W	15,000	W
Sand and gravel thousand short tons	10,014	9,962	10,771	11,178
Stone do	24,507	41,488	24,543	42,429
Talc and pyrophyllite short tons	109,393	513	100,030	520
Value of items that cannot be disclosed: Asbestos, cement, clays (kaolin), lithium minerals, olivine, phosphate rock, and values indicated by symbol W	XX	18,224	XX	20,544
Total	XX	77,094	XX	82,819
Total 1957–59 constant dollars	XX	r 71,919	XX	p 77,034

p Preliminary. r Revised. NA Not available. XX Not applicable.

W Withheld to avoid disclosing individual company confidential data.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes kaolin; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in North Carolina, by counties[1]

(Thousand dollars)

County	1967	1968	Minerals produced in 1968 in order of value
Alamance	W	W	Granite, miscellaneous clay.
Alexander	$20	$17	Sand and gravel.
Alleghany	W	W	Traprock.
Anson	W	W	Sand and gravel, granite.
Ashe	W	40	Granite.
Avery	W	W	Sand and gravel, mica, kaolin.
Beaufort	W	W	Phosphate rock, sand and gravel.
Bertie	5	71	Sand and gravel.
Bladen	131	147	Do.
Brunswick	51	35	Do.
Buncombe	W	W	Granite, sand and gravel.
Burke	W	W	Do.
Cabarrus	W	W	Traprock, granite, miscellaneous clay, sand and gravel.
Caldwell	W	410	Sand and gravel, granite.
Camden	5	4	Sand and gravel.
Carteret	4	3	Do.
Caswell	W	W	Granite, sand and gravel.
Catawba	W	W	Do.
Chatham	W	963	Granite, miscellaneous clay, traprock.
Cherokee	W	W	Marble, talc.
Chowan	4	2	Sand and gravel.
Clay	W	43	Limestone.
Cleveland	W	W	Lithium minerals, limestone, granite, mica, feldspar, sand and gravel.
Columbus	26	12	Sand and gravel.
Craven	W	W	Limestone, sand and gravel.
Cumberland	W	W	Sand and gravel, miscellaneous clay.
Currituck	16	16	Sand and gravel.
Dare	3	22	Do.
Davidson	W	505	Traprock, sand and gravel, slate, miscellaneous clay.
Davie	16	16	Sand and gravel.
Duplin	20	W	Do.
Durham	W	W	Traprock, miscellaneous clay.
Edgecombe	136	175	Sand and gravel.
Forsyth	W	W	Granite, sand and gravel.
Franklin	4	16	Sand and gravel.
Gaston	44	W	Do.
Gates	9	5	Do.
Granville	7	W	Pyrophyllite, sand and gravel.
Greene	16	13	Sand and gravel.
Guilford	W	W	Granite, traprock, miscellaneous clay.
Halifax	W	W	Granite, miscellaneous clay, sand and gravel.
Harnett	W	W	Sand and gravel, miscellaneous clay.
Haywood	W	W	Sand and gravel, granite.
Henderson	W	689	Granite, limestone.
Hertford	6	10	Sand and gravel.
Hoke	17	21	Do.
Hyde	2	2	Do.
Iredell	W	1,221	Granite, sand and gravel, miscellaneous clay.
Jackson	W	W	Granite, olivine.
Johnson	W	W	Traprock, sand and gravel, miscellaneous clay.
Jones	8	7	Sand and gravel.
Lee	375	W	Miscellaneous clay, sand and gravel.
Lenoir	W	W	Sand and gravel.
Lincoln	W	W	Granite, sand and gravel.
Macon	W	W	Granite, mica, sand and gravel.
Madison	6	W	Barite.
Martin	2	9	Sand and gravel.
McDowell	W	W	Do.
Mecklenburg	W	W	Granite.
Mitchell	3,362	4,403	Feldspar, mica, sand and gravel, sandstone.
Montgomery	W	W	Sandstone, miscellaneous clay, sand and gravel.
Moore	W	1,005	Granite, sand and gravel, pyrophyllite, miscellaneous clay.
Nash	W	W	Granite.
New Hanover	W	W	Cement, limestone, miscellaneous clay, sand and gravel.
Northampton	W	W	Sand and gravel.
Onslow	W	W	Limestone, sand and gravel.
Orange	W	W	Pyrophyllite, granite.
Pamlico	3	1	Sand and gravel.
Pasquotank	29	8	Do.
Pender	34	44	Do.
Perquimans	6	22	Do.
Person	3	1	Do.
Pitt	W	W	Granite, sand and gravel.
Polk	W	W	Do.

See footnotes at end of table.

Table 2.—Value of mineral production in North Carolina, by counties[1]—Continued

(Thousand dollars)

County	1967	1968	Minerals produced in 1968 in order of value
Randolph	W	W	Granite.
Richmond	$10	$56	Granite, sand and gravel.
Robeson	234	219	Sand and gravel.
Rockingham	W	W	Granite, miscellaneous clay, sand and gravel.
Rowan	W	W	Do.
Rutherford	W	W	Granite, sand and gravel.
Sampson	40	62	Miscellaneous clay, sand and gravel.
Scotland	10	21	Sand and gravel.
Stanly	284	W	Miscellaneous clay.
Stokes	144	209	Miscellaneous clay, sand and gravel.
Surry	W	2,502	Granite, traprock, sand and gravel.
Swain	148	116	Limestone.
Transylvania	3	W	Granite, sand and gravel.
Union	W	W	Traprock, miscellaneous clay, granite, sand and gravel.
Vance	W	W	Granite.
Wake	W	W	Granite, sand and gravel.
Washington	4	17	Sand and gravel.
Watauga	W	W	Do.
Wayne	76	122	Do.
Wilkes	W	W	Granite, sand and gravel.
Wilson	W	W	Do.
Yadkin	W	W	Sand and gravel, granite.
Yancey	W	W	Mica, olivine, sand and gravel, asbestos.
Undistributed	71,771	69,536	
Total[2]	77,094	82,819	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Graham, Tyrrell, and Warren.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Selected indicators of North Carolina business activity

	1967	1968 [p]	Change (percent)
Employment and labor force, annual average:			
Total labor force ... thousands	2,081	2,132	+2.5
Unemployment ... do	71	68	−4.7
Employment ... do	2,010	2,064	+2.7
Construction ... do	92	94	+2.4
All manufacturing ... do	666	694	+4.2
Total nonfarm wage and salary ... do	1,584	1,658	+4.6
Payrolls, factory ... millions	$2,795	$3,158	+13.0
Personal income:			
Total ... do	[r] $12,267	$13,350	+8.8
Per capita	[r] $2,425	$2,606	+7.5
Construction activity:			
Value of building permits in 13,000 places ... millions	[r] $295	$355	+20.3
State Highway Commission:			
Value of contracts awarded ... do	$138	$136	−1.6
Cement shipments to North Carolina ... thousand 376-pound barrels	7,477	7,684	+2.8
Farm marketing receipts ... millions	[r] $1,341	$1,257	−6.3
Mineral production ... do	$77	$83	+7.4
Consumption of electric energy ... thousand kwh	28,976	32,363	+12.4
Export trade ... millions	$165	$179	+8.5
Import trade ... do	$176	$209	+18.8

[r] Revised. [p] Preliminary.

Source: U.S. Department of Commerce.

Employment increased more than the labor force, resulting in a 4.7 percent reduction in unemployment. Farm marketing receipts, 6.3 percent lower than 1967, was the only other indicator in the selected list which decreased significantly. Changes in the North Carolina indicators, in general, were comparable to changes in the same indicators for the United States, with the exception of manufacturing employment, which increased 4.2 percent, as compared with the total U.S. increase of 1.6 percent.

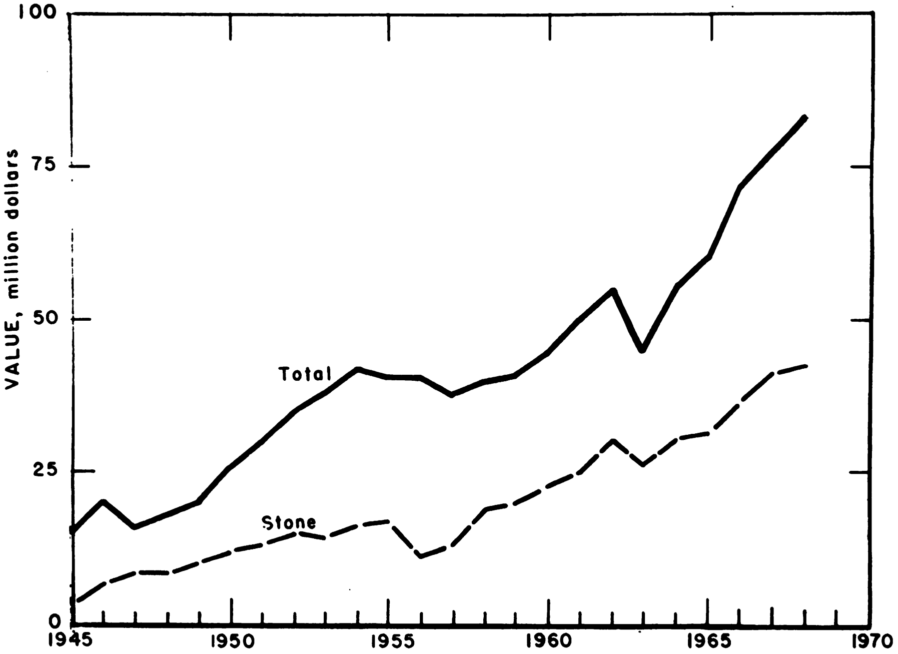

Figure 1.—Value of stone and total value of mineral production in North Carolina.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1967:								
Metal	2	20	(1)	(1)	-------	-------	-------	-------
Nonmetal	1,741	245	426	3,417	-------	109	31.90	1,139
Sand and gravel	834	232	193	1,733	-------	52	30.01	631
Stone	1,899	254	483	4,020	2	55	14.18	3,480
Total	4,476	246	1,102	9,170	2	216	23.77	2,069
1968:p								
Metal	5	10	(1)	(1)	-------	-------	-------	-------
Nonmetal	1,955	257	503	4,068	1	120	29.74	2,095
Sand and gravel	895	228	204	1,798	1	39	22.25	3,725
Stone	1,975	234	461	3,807	2	50	13.66	7,567
Total	4,830	242	1,169	9,674	4	209	22.02	4,552

p Preliminary.
[1] Less than ½ unit.

Trends and Developments.—The Atomic Energy Commission received an application from Carolina Power and Light Co., of Raleigh, for a permit to build a two-unit nuclear powerplant near Southport, Brunswick County. Each unit will use a boiling water reactor and have an initial net capacity of 821,000 kilowatts. The first unit should be ready for commercial production by March 1973.

International Minerals & Chemicals Co. acquired the mining and processing assets of Northwest Carolina Olivine Co., which operates a mine and plant at Burnsville.

Lithium Corporation of America, Inc. was developing a new lithium mine northwest of Bessemer City. Spodumene will be extracted from a 200-acre area at a rate of about 1,200 tons per day of raw ore. Open-pit mining methods will be used, and the ore upgraded in a heavy media plant. The concentrate will go to the company's chemical plant in Bessemer City.

Ranchers Exploration and Development Corp. acquired the Hamme tungsten mine near Henderson, Vance County. The mine was closed in 1963, after the price of tungsten declined. The company plans to begin production in 1970.

Legislation and Government Programs.—A study of the potential for phosphate-based manufacturing in North Carolina was being conducted by the Industrial Extension Service of North Carolina State University. The extensive use of phosphate chemicals by industry, together with the large phosphate reserves in eastern North Carolina, was the basis for the study.

The State Board of Water and Air Resources declared that a seven-county region of eastern North Carolina, including Beaufort, Pamlico, Washington, and parts of Carteret, Craven, Hyde, and Tyrrell Counties, is a "capacity use area" where water usage is approaching a degree which requires coordination and regulation. Regulations were being drafted for consideration.

The Office of Water Resources Research, Department of Interior, approved a matching grant of $26,800 in Federal funds to finance a computer study of the effects of phosphate mining in eastern North Carolina on the groundwater resources of the region. The Consolidated University of North Carolina is providing the matching State funds.

REVIEW BY MINERAL COMMODITIES

NONMETALS

The mineral production of the State consisted entirely of nonmetals.

Asbestos.—Asbestos was produced near Burnsville, Yancey County. Output was somewhat less than in 1967.

Barite.—Production of barite near Stackhouse, Madison County, was significantly greater than that of 1967, the only other year in which barite had been mined since 1961.

Cement.—Portland cement production increased slightly over 1967. Three types of portland cement were produced: General use, moderate heat, and high-early strength. Fifty percent of the portland cement was shipped to points within the State, 32 percent to Florida, 14 percent to South Carolina, and the remaining 4 percent to other States and foreign countries. Masonry cement shipments were 76 percent within the State, 18 percent to South Carolina, and the remaining 6 percent to other States. Bulk shipments moved 59.9 percent by truck, 39.7 percent by railroad, and 0.4 percent by water. Sales of portland cement were to ready-mix concrete companies (49 percent), highway contractors (18 percent), concrete product manufacturers (14 percent), building material dealers (13 percent), and others (6 percent).

Clay.—Miscellaneous clay production increased 11 percent and value 7 percent over the 1967 figures. The increase was due to greater construction activity with consequently greater use of brick and lightweight aggregate. Twenty-four companies mined miscellaneous clay at 34 mines which was used in manufacturing brick (69 percent), lightweight aggregate (20 percent), and other (11 percent).

Harris Mining Co., Avery County, remained the sole producer of kaolin. Production decreased 14 percent, and value decreased 22 percent. The kaolin was used primarily for refractories.

Feldspar.—Feldspar output increased both in quantity and value, in response to greater demand for feldspar in the glass and pottery industries. Price increases during the year caused a greater increase in total value than in quantity. Production was predominantly mixed feldspars. Sixty-six percent was marketed as crude feldspar or flotation concentrate, while 34 percent received further grinding after flotation. Crude or flotation concentrate was used

Table 5.—Miscellaneous clay sold or used by producers, by counties

County	1967			1968		
	Number of mines	Short tons	Value	Number of mines	Short tons	Value
Cabarrus	------	-----------	-----------	1	100,000	$68,000
Chatham	3	308,486	$210,000	3	W	W
Cumberland	1	W	W	1	36,000	24,500
Guilford	1	80,384	53,000	3	178,044	111,000
Lee	4	477,500	325,600	4	470,000	314,380
Rowan	2	W	W	3	223,328	151,900
Sampson	1	30,540	20,200	1	50,054	34,000
Stanly	3	428,680	284,000	3	W	W
Stokes	1	193,663	128,000	1	217,015	147,600
Union	1	166,612	110,000	1	180,000	90,000
Undistributed [1]	14	1,290,796	881,277	13	1,855,591	1,206,170
Total	31	2,976,661	2,012,077	34	3,310,032	2,147,550

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes Alamance, Catawba (1967), Davidson, Durham, Halifax, Harnett, Iredell (1968), Johnston Montgomery, Moore (1968), New Hanover, and Rockingham Counties, and counties indicated by symbol W'

mainly in glass manufacture, and ground feldspar was used for pottery (95 percent) and enamel (5 percent). Shipments of ground feldspar were made to Ohio (33 percent), Pennsylvania (12 percent), Illinois (8 percent), and other States (47 percent).

Lithium Minerals.—Spodumene production at Kings Mountain, Cleveland County, increased in both tonnage and value. Part of the spodumene concentrate was used by the ceramic industry, and some was converted to lithium chemicals at Lithium Corporation of America's Bessemer City plant, Gaston County.

Mica.—Scrap mica production was 69,000 tons, a decrease of 1 percent from that of 1967; value also decreased slightly. Nine companies reported production from 14 mines in Cleveland, Mitchell, Yancey, Avery, and Macon Counties. Ground mica output increased 8 percent in tonnage and 15 percent in value. Eight companies ground mica at nine plants in 1968; six plants used dry methods, two used wet methods, and one used both wet and dry methods. Ground mica was used for roofing (41 percent), paint (18 percent), rubber (9 percent), and other uses (32 percent). Production of sheet mica totaled 15,000 pounds, over three times that of 1967.

Olivine.—Output of olivine decreased 18 percent and value decreased 19 percent. The material was used for molding sand and refractory products. Two mines were active; one in Jackson County and one in Yancey County.

Perlite.—Crude perlite produced in other States was expanded at a plant at Gold Hill, Rowan County. Quantity and value increased substantially.

Table 6.—Ground mica sold or used by producers, by uses

Use	1967		1968	
	Short tons	Value	Short tons	Value
Roofing	19,872	$666,671	21,494	$717,030
Paint	7,324	979,369	9,591	1,353,461
Rubber	4,538	607,899	4,905	690,572
Wallpaper	W	W	549	78.288
Plastics	570	76,115	548	77,850
Other uses [1]	16,385	862,014	15,731	748,742
Total	48,689	3,192,068	52,818	3,665,943

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes textile coating, well drilling and other uses, and uses indicated by symbol W.

Phosphate Rock.—Production of phosphate rock at the Lee Creek fertilizer complex, Beaufort County, increased 29 percent in quantity and 42 percent in value. Production has increased each year since the mine opened in April 1966, and the mine and plant are approaching the design capacity of 3.0 million tons per year. An expansion of facilities was being planned. Of significance to companies having phosphate holdings in the area was the opening of the North Carolina State Ports Authority phosphate terminal at Morehead City. The first shipment of phosphate rock left the terminal on August 18, bound for West Germany. The terminal will enable North Carolina production to enter the growing phosphate export market now dominated by Florida producers.

FMC Corp. exercised options to buy over 3,000 acres of phosphate ore reserves in Beaufort County. The property is across the Pamlico River from the phosphate mining and processing operations of Texas Gulf Sulphur Co., near Aurora. Although there are no immediate plans for mining and processing operations at the site, the phosphate ore eventually will be mined by an underground hydraulic method developed by FMC Corp. The company further plans to convert the ore to elemental phosphorus, using electric furnaces, and then to phosphoric acid, rather than treating the ore by the conventional acidulation with sulfuric acid process.

Table 7.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1967			1968		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Alexander	1	48	$20	1	42	$17
Anson	4	1,946	W	4	1,986	2,832
Avery	2	W	W	3	229	297
Beaufort	1	142	43	1	134	38
Bertie	1	19	5	2	79	71
Bladen	1	202	131	1	216	147
Brunswick	1	75	51	1	50	35
Buncombe	2	W	W	4	450	657
Caldwell	1	W	W	2	166	247
Camden	1	8	5	1	6	4
Carteret	1	12	4	1	10	3
Caswell	1	8	8	1	4	4
Catawba	1	55	23	1	49	20
Chowan	1	14	4	1	8	2
Columbus	1	31	26	1	17	12
Craven	2	94	W	2	W	W
Cumberland	2	350	W	2	W	W
Currituck	1	24	16	1	23	16
Dare	1	5	3	1	31	22
Davidson	1	358	179	1	380	190
Davie	1	24	16	1	25	16
Duplin	2	28	20	2	W	W
Edgecombe	3	141	136	3	179	175
Forsyth	2	W	W	2	83	141
Franklin	1	9	4	1	16	16
Gaston	2	70	44	2	W	W
Gates	1	13	9	1	7	5
Granville	1	4	7	1	4	5
Greene	1	54	16	1	47	13
Halifax	1	49	19	1	45	23
Harnett	4	1,987	2,211	3	W	W
Haywood	1	270	W	2	W	W
Hertford	1	25	6	1	41	10
Hoke	1	25	17	1	30	21
Hyde	1	8	2	1	7	2
Iredell	1	72	31	1	251	375
Johnston	1	37	37	1	95	87
Jones	1	28	8	1	24	7
Lee	1	80	49	2	W	W
Lincoln	1	61	30	1	46	23
Macon	1	89	90	1	16	W
Martin	1	10	2	1	34	9
McDowell	4	51	42	3	W	W
Mitchell	3	202	177	3	387	302

See footnotes at end of table.

Table 7.—Sand and gravel sold or used by producers, by counties—Continued

(Thousand short tons and thousand dollars)

County	1967			1968		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Montgomery	1	20	$3	1	18	$7
Moore	6	523	327	5	427	281
New Hanover	1	5	3	1	20	8
Onslow	1	25	17	1	32	22
Pamlico	1	10	3	1	2	1
Pasquotank	1	42	29	1	33	3
Pender	1	50	34	1	63	44
Perquimans	1	9	6	1	31	22
Person	1	2	3	1	1	1
Pitt	3	200	98	3	196	96
Polk	1	16	6	1	16	7
Richmond	1	16	10	1	16	11
Robeson	1	368	234	1	328	219
Rockingham	1	2	2	1	2	2
Rowan	1	53	26	1	89	20
Rutherford	1	106	42	1	181	46
Sampson	1	30	20	1	30	28
Scotland	1	18	10	1	45	21
Stokes	1	25	16	1	94	61
Surry	1	1	2	1	3	4
Transylvania	1	2	3	1	W	W
Union	1	49	37	1	22	16
Vance	1	4	2	--------	--------	--------
Wake	1	6	4	1	5	4
Washington	1	16	4	1	67	17
Wayne	2	99	76	2	W	122
Wilkes	1	7	11	1	18	22
Wilson	3	73	63	3	76	86
Yadkin	1	2	3	1	1	2
Undistributed [1]	17	1,512	5,372	15	3,843	4,156
Total	120	10,014	9,962	121	10,771	11,178

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes Ashe (1967), Burke, Cabarrus, Clay (1967), Cleveland, Lenoir, Northampton, Watauga, and Yancey Counties, and counties indicated by symbol W.

Table 8.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967		1968	
	Quantity	Value	Quantity	Value
Sand:				
Paving	2,656	$1,859	3,067	$2,255
Structural	2,563	2,088	2,868	2,676
Fill	680	434	385	287
Other sands [1]	548	229	590	242
Total	6,447	4,610	6,910	5,460
Gravel:				
Paving	1,989	2,140	2,080	2,396
Structural	901	1,652	1,172	2,057
Miscellaneous	604	1,488	W	W
Other gravel [2]	73	72	609	1,265
Total	3,567	5,352	3,861	5,718
Total sand and gravel	10,014	9,962	10,771	11,178

W Withheld to avoid disclosing individual company confidential data; included with "Other gravel."

[1] Includes railroad ballast, blast, filtration, and other sands.

[2] Includes railroad ballast, fill, miscellaneous, and other gravel.

Sand and Gravel.—Sand and gravel was again the second leading mineral commodity produced in the State. Tonnage increased 8 percent and value 12 percent owing to increased construction activity. Sand and gravel was produced in 79 of the State's 100 counties. Fifty commercial operations produced 64 percent of the total, the remainder being produced by 71 government-and-contractor operations. Commercial operations provided all of the sand and gravel used for building purposes, 41 percent of that used for paving, and 49 percent of that used for railroad ballast, fill, and other purposes. Five of the 50 commercial operations produced 63 percent of the commercial sand and gravel. Transportation of commercial sand and gravel was 58 percent by truck and 42 percent by railroad.

Stone.—Stone was again the principal mineral commodity produced in the State in terms of tonnage and value, comprising 51 percent of the total output value. Total tonnage was virtually unchanged, while value increased about 2 percent.

Crushed stone accounted for 99.8 percent of the total tonnage and 94 percent of the total value of stone production. Crushed granite, the leading stone product, decreased 3 percent in quantity, but increased 3 percent in value; crushed limestone increased in both tonnage and value; crushed traprock increased 3 percent in tonnage and 4 percent in value; while both crushed marble and sandstone decreased in tonnage and value.

Dimension granite decreased 11 percent in quantity and 21 percent in value; dimension marble and slate also showed significant decreases in tonnage and value.

Thirty-four companies were engaged in stone production during the year. A total of 95 commercial quarries were active; 70 granite, nine limestone, eight traprock, five sandstone, two marble, and one slate. The State Highway Department crushed stone at four granite and two traprock quarries.

The major uses for crushed stone were as road base material and concrete and bituminous aggregate. Dimension stone was used for curbing, monuments, paving blocks, house stone veneer, and flagging.

Transportation of stone was predominantly by truck (88 percent), followed by railroad (8 percent), and by waterway and unspecified methods (4 percent).

Talc and Pyrophyllite.—Talc and pyrophyllite production decreased 9 percent in quantity, but increased 1 percent in value. Talc was sawed into crayons (5 percent), and ground for use in toilet preparations (64 percent), textiles (30 percent), and drugs (1 percent). Pyrophyllite was ground for use in refractories (36 percent), ceramics (22 percent), insecticides (21 percent), brick (10 percent), paint (4 percent), rubber (3 percent), and other products (4 percent).

Vermiculite.—Crude vermiculite, shipped into the State, was exfoliated at two plants, one each in Lee and Guilford Counties. The finished product was used principally for loose fill insulation (55 percent), concrete aggregate (38 percent), agriculture (3 percent), building plaster (2 percent), and other uses (2 percent).

Table 9.—Crushed granite sold or used by producers, by counties

County	1967			1968		
	Number of quarries	Short tons	Value	Number of quarries	Short tons	Value
Alleghany	1	3,385	$5,077	---	---	---
Ashe	1	W	W	1	W	$40,000
Cabarrus	1	98,870	147,555	1	79,485	121,500
Caldwell	1	W	W	1	106,251	162,600
Jackson	1	W	W	1	38,000	61,700
Macon	1	146,318	146,318	1	111,415	139,269
Orange	1	11,125	16,700	1	6,590	11,530
Richmond	---	---	---	1	30,000	45,000
Transylvania	---	---	---	1	W	162,956
Undistributed [1]	55	16,652,932	25,581,806	56	16,113,857	25,877,155
Total	62	16,912,130	25,897,456	64	16,485,548	26,621,710

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes Alamance, Anson (1968), Buncombe, Burke, Caswell, Catawba, Chatham, Cleveland, Forsyth, Guilford, Halifax, Haywood, Henderson, Iredell, Lincoln, McDowell (1967), Mecklenburg, Moore, Nash, Pitt, Polk, Randolph, Rockingham, Rowan, Rutherford, Surry, Union (1968), Vance, Wake, Wilkes, Wilson, and Yadkin Counties, and counties indicated by symbol W.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum: Aluminum Company of America	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	Smelter	Stanly.
Asbestos: Powhatan Mining Co	6721 Windsor Mill Road Baltimore, Md. 21207	Open-pit mine	Yancey.
Barite: Fluid Power Pump Co	Box 428 Hot Springs, N.C. 28743	do	Madison.
Cement: Ideal Cement Co	620 Denver National Bldg. Denver, Colo. 80202	Plant	New Hanover.
Clay:			
Kaolin: Harris Mining Co	Box 429 Spruce Pine, N.C. 28777	Open-pit mine and plant	Avery.
Miscellaneous:			
Boren Clay Products Co	Pleasant Garden, N.C. 27313	5 open-pit mines	Chatham, Guilford, Sampson.
Carolina Solite Corp	Box 9138 Richmond, Va. 23227	Open-pit mine and plant	Stanly.
Pine Hall Brick and Pipe Co	Box 4325, North Station Winston-Salem, N.C. 27105	do	Stokes.
Sanford Brick Corp	Box 38 Gulf, N.C. 27256	3 open-pit mines and plant	Chatham, Lee, Stanly.
Virginia Solite Corp	Box 9138 Richmond, Va. 23227	Open-pit mine and plant	Rockingham.
Feldspar:			
The Feldspar Corp.[1]	Spruce Pine, N.C. 28777	3 open-pit mines and 2 plants	Mitchell.
Foote Mineral Co	Box 792 Kings Mountain, N.C. 28086	Open-pit mine and plant	Cleveland.
International Minerals & Chemical Corp.[1]	Old Orchard Road Skokie, Ill. 60079	do	Mitchell.
Kings Mountain Mica Co	Box 709 Kings Mountain, N.C. 28086	2 open-pit mines and 2 plants	Cleveland.
Lawson-United Feldspar and Mineral Co.[1]	Minpro, N.C. 28777	Open-pit mine and plant	Mitchell.
Lime, regenerated:			
Albemarle Paper Manufacturing Co	Roanoke Rapids, N.C. 27870	Plant	Halifax.
Riegel Paper Corp	Riegelwood, N.C. 28456	do	Columbus.
U.S. Plywood-Champion Papers, Inc	Canton, N.C. 28716	do	Haywood.
Weyerhaeuser Co	New Bern, N.C. 28560	do	Craven.
Weyerhaeuser Co	Plymouth, N.C. 27962	do	Washington.
Lithium minerals: Foote Mineral Co	Box 792 Kings Mountain, N.C. 28086	Open-pit mine and plant	Cleveland.
Mica, scrap:			
Deneen Mica Co., Inc	Newdale, N.C. 28714	2 open-pit mines and 1 plant	Yancey.
The Feldspar Corp	Box 220 Spruce Pine, N.C. 28777	3 open-pit mines and 2 plants	Mitchell.
Harris Mining Co	Box 429 Spruce Pine, N.C. 28777	3 open-pit mines and 1 plant	Avery and Mitchell.
Kings Mountain Mica Co., Inc	Box 709 Kings Mountain, N.C. 28086	2 open-pit mines and 2 plants	Cleveland.
United States Gypsum Co	101 South Wacker Drive Chicago, Ill. 60606	1 open-pit mine	Cleveland.

Mica, sheet: Eugene Owenby	Route 4 Franklin, N.C. 28734	do	Macon.
Mica grinders:			
Carolina Southern Mining Co., Inc	Box 429 Spruce Pine, N.C. 28777	Plant	Mitchell.
Deneen Mica Co	Newdale, N.C. 28714	2 open-pit mines and 1 plant	Yancey.
Diamond Mica Co	Spruce Pine, N.C. 28777	Two plants	Mitchell, Yancey.
The English Mica Co	Ridgeway Center Bldg. Stamford, Conn. 06905	Plant	Cleveland.
Harris Mining Co	Box 429 Spruce Pine, N.C. 28777	3 open-pit mines and 1 plant	Mitchell.
Olivine:			
Harbison-Walker Refractories Co	Gateway #2 Pittsburgh, Pa. 15222	Open-pit mine	Jackson.
Northwest Carolina Olivine, Inc	Box 672 Spruce Pine, N.C. 28777	Open-pit mine and plant	Yancey.
Perlite, expanded: Carolina Perlite Co., Inc	Box 741 Hillside, N.J. 07205	Plant	Rowan.
Phosphate rock: Texas Gulf Sulphur Co	200 Park Avenue New York, N.Y. 10017	Open-pit mine and plant	Beaufort.
Sand and gravel:			
Becker Sand & Gravel Co	Box 848 Cheraw, S.C. 29520	3 open-pit mines	Cumberland, Harnett, Moore.
W. R. Bonsal Co., Inc	Box 38 Lilesville, N.C. 28091	Open-pit mine	Anson.
Grove Stone and Sand, Branch of B. V. Hedrick Gravel and Stone Co.	Swannanoa, N.C. 28778	do	Buncombe.
Lessees of B. V. Hedrick Gravel and Sand Co	Lilesville, N.C. 28091	do	Anson.
Nello L. Teer Co	Box 1131 Durham, N.C. 27702	do	Harnett.
Stone:			
Granite, crushed:			
Central Rock Co	Box 510 Greensboro, N.C. 27409	Quarry	Guilford.
Foote Mineral Co	Box 792 Kings Mountain, N.C. 28086	Open-pit mine	Cleveland.
Superior Stone Co	Box 2568 Raleigh, N.C. 27602	Twenty-seven quarries	Alamance, Catawba, Chatham, Cleveland, Gaston, Guilford, Halifax, Iredell, Lincoln, Mecklenburg, Moore, Pitt, Randolph, Rockingham, Rowan, Union, Wake, Wilson.
Nello L. Teer Co	Box 1131 Durham, N.C. 27702	4 quarries	Nash, Wake, Wilson.
Vulcan Materials Co	Box 7506, Reynolds Station Winston-Salem, N.C. 27106	12 quarries	Buncombe, Caswell, Forsyth, Guilford, Haywood, Henderson, Surry, Vance, Wilkes, Yadkin.
Granite, dimension:			
Comolli Granite Co	Box 898 Elberton, Ga. 30635	Quarry	Rowan.
Duke University	Durham, N.C. 27700	do	Orange.
Harris Granite Quarries	Box 1038 Salisbury, N.C. 28144	do	Rowan.

See footnote at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Granite, dimension—Continued			
Herman Stone Co	100 Commerce Park Drive Dayton, Ohio 45404	Quarry	Rowan.
North Carolina Granite Corp	Box 151 Mount Airy, N.C. 27030	do	Surry.
Limestone, crushed:			
Cogdill Limestone Co., Inc	Box 116 Fletcher, N.C. 28732	do	Henderson.
Fletcher Limestone Co., Inc	Fletcher, N.C. 28732	do	Do.
Ideal Cement Co	620 Denver National Bldg. Denver, Colo. 80202	do	New Hanover.
Nantahala Talc & Limestone Co	Andrews, N.C. 28901	2 quarries	Clay, Swain.
Superior Stone Co	Box 2568 Raleigh, N.C. 27602	4 quarries	Cleveland, Craven, New Hanover, Onslow.
Marble, crushed and dimension: Moretti-Harrah Marble Co.	Box 330 Sylacauga, Ala. 35150	Quarry	Cherokee.
Slate, dimension: Jacob's Creek Stone Co., Inc	Mount Gilead, N.C. 27306	do	Davidson.
Sandstone, crushed:			
The Feldspar Corp	Spruce Pine, N.C. 28777	3 open-pit mines and 2 plants	Mitchell.
Southern Aggregates, Inc	Box 1198 Roanoke, Va. 24006	Quarry	Montgomery.
Thomas & Woody Mining Co	Box 315 Spruce Pine, N.C. 28777	do	Do.
Sandstone, dimension: Jacob's Creek Stone Co., Inc	Mount Gilead, N.C. 27306	do	Do.
Traprock, crushed:			
Ararat Rock Products Co	223 Willow St. Mount Airy, N.C. 27030	2 quarries	Alleghany, Surry.
Nello L. Teer Co	Box 1131 Durham, N.C. 27702	do	Durham and Johnson.
Superior Stone Co	Box 2568 Raleigh, N.C. 27602	3 quarries	Davidson, Guilford.
Young Stone Co	Box 11424 Charlotte, N.C. 28209	Quarry	Cabarrus.
Talc and pyrophyllite:			
Pyrophyllite:			
Boren & Harvey, Inc	Box 7247 Greensboro, N.C. 27407	Open-pit mine	Granville.
General Minerals Co	Box 3504 Greensboro, N.C. 27402	do	Moore.
Piedmont Minerals Co., Inc	P.O. Box 7247 Greensboro, N.C. 27407	Open-pit mine and plant	Orange.
Standard Minerals Co., Inc	Robbins, N.C. 27325	do	Moore.
Talc: Hitchcock Corp	Box 35 Murphy, N.C. 28906	Underground mine and plant	Cherokee.
Vermiculite, expanded:			
Lee-V-Lite, Inc	Box 537 Sanford, N.C. 27330	Plant	Lee.
W. R. Grace & Co	62 Whittemore Ave. Cambridge, Mass. 02140	do	Guilford.

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[1] Also feldspar grinding.

The Mineral Industry of North Dakota

This chapter has been prepared by the Bureau of Mines, U.S. Department of the Interior, and the State Geological Survey of North Dakota under a cooperative agreement for collecting information on all minerals except fuels.

By Franklin H. Persse [1] and William C. Henkes [2]

The value of mineral production during 1968 in North Dakota was $98 million, essentially the same as in 1967. The value of mineral fuels was virtually unchanged, nonmetals increased 3 percent, while metals declined 51 percent. The lower production value of metals resulted from decreased shipments of uranium and no shipments of byproduct molybdenum.

Table 1.—Mineral production in North Dakota [1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Coal ..... thousand short tons	4,156	$7,967	4,487	$7,986
Gem stones	NA	1	NA	1
Natural gas (marketed) ..... million cubic feet	40,462	6,686	41,028	6,769
Natural gas liquids:				
LP gases ..... thousand 42-gallon barrels	2,111	8,901	2,156	8,622
Natural gasoline and cycle products ..... do	554	1,443	558	1,479
Petroleum (crude) ..... do	25,315	65,818	25,040	66,106
Sand and gravel ..... thousand short tons	8,822	9,118	10,839	10,159
Stone ..... do	596	1,092	165	826
Value of items that cannot be disclosed: Clays, lime, molybdenum (1967), peat, salt, uranium [2] (recoverable content U_3O_8)	XX	1,562	XX	1,588
Total	XX	97,538	XX	98,036
Total 1957–59 constant dollars	XX	r 95,224	XX	p 94,901

p Preliminary. r Revised. NA Not available. XX Not appliable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] 1967 value estimated based on $8.00 per pound f.o.b. mill; 1968 value estimated based on $8.00 per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 per pound for commercial sales.

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[1] Mining engineer, Bureau of Mines, Denver, Colo.

[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

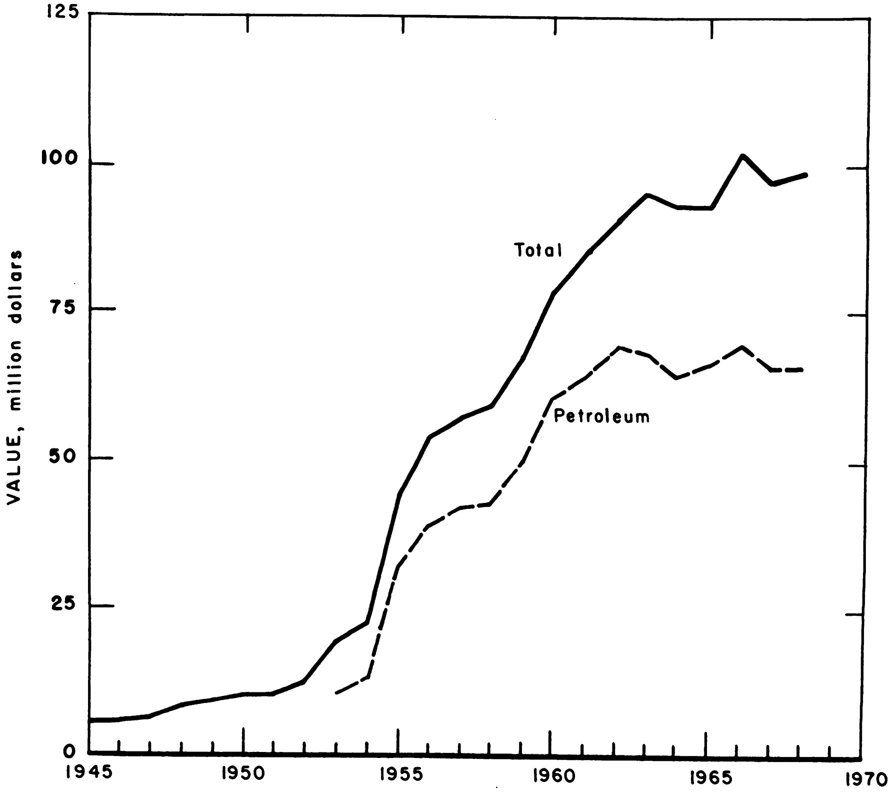

Figure 1.—Value of petroleum and total value of mineral production in North Dakota.

Legislation and Government Programs.—The State Highway Department awarded construction contracts in the amount of $13.5 million for work on Interstate highways and $7.6 million for work on primary and secondary systems. An additional $6 million was awarded to contractors and State forces for maintenance.[3] Interstate highway mileage open to traffic remained the same as in 1967; but at yearend 77.2 miles were under construction, 56.7 miles more than in 1967.[4] The greater mileage under construction increased the use of sand and gravel.

Among Government publications of interest to the North Dakota coal industry, two were published by the Bureau of Mines[5] and one by the U.S. Geological Survey.[6] Other publications of interest to the mineral industries included an article on cement-rock possibilities in eastern North Dakota[7] and two on ground water.[8]

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[3] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1969 and Budgets for Maintenance. V. 182, No. 14, Apr. 3, 1969, pp. 52–53.

[4] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1968. Press Release FHWA-295, Feb. 24, 1969.

[5] Kube, Wayne R., and James L. Elder. Technology and Use of Lignite. Proceedings: Bureau of Mines-University of North Dakota Symposium, Grand Forks, N. Dak., Apr. 27–28, 1967. BuMines Inf. Circ. 8376, May 1968, 201 pp.

Sondreal, Everett A., Wayne R. Kube, and James L. Elder. Analysis of the Northern Great Plains Province Lignites and Their Ash: A Study of Variability. BuMines Rept. of Inv. 7158, 1968, 94 pp.

[6] Averitt, Paul. Stripping-Coal Resources of the United States. U.S. Geol. Survey Bull. 1252–C, 1968, 20 pp.

[7] Anderson, Sidney B., and Harold C. Haraldson. Cement-Rock Possibilities in Paleozoic Rocks of Eastern North Dakota. North Dakota Geol. Survey Rept. of Inv. 48, 1968, 62 pp.

[8] Buturla, Jr., Frank. Geology and Ground Water Resources of Wells County. Part 2—Ground Water Basic Data. North Dakota Geol. Survey Bull. 51, 1968, 118 pp.

Kelly, T. E. Geology and Ground Water Resources of Grand Forks County, Part 2—Ground Water Basic Data. North Dakota Geol. Survey Bull. 53, 1968, 117 pp.

Table 2.—Value of mineral production in North Dakota, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Adams	$76	$98	Sand and gravel, coal (lignite).
Barnes	543	257	Sand and gravel.
Benson	213	397	Do.
Billings	6,473	6,516	Petroleum, natural gas, sand and gravel, uranium.
Bottineau	6,501	6,613	Petroleum, sand and gravel, natural gas, peat.
Bowman	2,502	2,205	Petroleum, coal (lignite), sand and gravel, stone, natural gas.
Burke	9,939	9,487	Petroleum, natural gas, coal (lignite), LP gases, sand and gravel, natural gasoline.
Burleigh	952	502	Sand and gravel.
Cass	147	148	Do.
Cavalier	87	211	Do.
Dickey	127	14	Do.
Divide	1,015	1,169	Petroleum, sand and gravel, natural gas, clays.
Dunn	62	147	Sand and gravel, petroleum, natural gas.
Eddy	395	260	Sand and gravel.
Emmons	209	212	Do.
Foster	174	89	Do.
Golden Valley	15	54	Do.
Grand Forks	444	494	Do.
Grant	96	77	Coal (lignite), sand and gravel.
Griggs	533	237	Sand and gravel, stone.
Hettinger	39	2	Sand and gravel.
Kidder	329	26	Do.
La Moure	W	153	Sand and gravel, stone.
Logan	88	12	Sand and gravel.
McHenry	184	268	Sand and gravel, petroleum, natural gas.
McIntosh	200	169	Sand and gravel.
McKenzie	20,531	18,440	Petroleum, natural gas, stone, sand and gravel.
McLean	698	388	Sand and gravel, coal (lignite).
Mercer	5,328	5,671	Coal (lignite), stone, sand and gravel.
Morton	252	223	Sand and gravel, clays, coal (lignite), stone.
Mountrail	2,770	3,022	Petroleum, natural gas, sand and gravel.
Nelson	125	253	Sand and gravel.
Oliver	299	312	Coal (lignite), sand and gravel, stone.
Pembina	W	661	Lime, sand and gravel.
Pierce	433	46	Sand and gravel.
Ramsey	134	368	Do.
Ransom	203	135	Do.
Renville	5,690	5,667	Petroleum, sand and gravel, natural gas.
Richland	132	175	Sand and gravel.
Rolette	135	127	Do.
Sargent	141	16	Do.
Sheridan	13	15	Do.
Sioux	162	106	Do.
Slope	305	289	Petroleum, sand and gravel, natural gas.
Stark	2,979	4,543	Petroleum, sand and gravel, coal (lignite), natural gas, uranium, stone.
Steele	126	111	Sand and gravel.
Stutsman	445	432	Sand and gravel, stone.
Towner	36	82	Sand and gravel.
Traill	57	701	Do.
Walsh	127	149	Sand and gravel, stone.
Ward	1,241	1,715	Coal (lignite), petroleum, sand and gravel, natural gas.
Wells	175	216	Sand and gravel.
Williams	23,145	24,355	Petroleum, LP gases, natural gas, natural gasoline, salt, sand and gravel, coal (lignite).
Undistributed	[1] 510	1	Gem stones.
Total [2]	97,538	98,036	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.
[2] Data may not add to total shown because of independent rounding.

A report on refractory-clay deposits was placed on open file at the Denver Office of Mineral Resources, Denver, Colo., and in the Central Library of the U.S. Department of the Interior, Washington, D.C.[9]

Employment and Injuries.—Final statistics for 1967 and preliminary data for 1968 of employment and injuries in the mineral industry, exclusive of the mineral fuels industries except coal and peat, are given in table 4.

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[9] Holmes, R. W., and Joel N. Van Sant. Refractory-Clay Deposits of Nebraska, North Dakota, and South Dakota. BuMines Open-File Rept., 1968, 113 pp.

Table 3.—Indicators of North Dakota business activity

	1967 r	1968 p	Change (percent)
Employment and labor force, annual average:			
Total labor force .... thousands..	248.0	249.6	+.6
Total employment .... do....	237.7	239.4	+.7
Total unemployment .... do....	10.3	10.2	−1.0
Total agricultural employment .... do....	65.2	63.5	−2.6
Total nonagricultural employment .... do....	172.5	175.9	+2.0
Mining .... do....	1.9	1.9	--------
Contract construction .... do....	8.5	8.0	−5.9
Manufacturing .... do....	8.7	8.9	+2.3
Finance, insurance, real estate .... do....	6.6	6.8	+3.0
Transportation and utilities .... do....	12.2	12.3	+.8
Trade .... do....	41.9	42.1	+.5
All other .... do....	92.7	95.9	+3.5
Personal income:			
Total .... millions..	$1,589.0	$1,761.0	+10.8
Per capita	$2,487.0	$2,808.0	+12.9
Construction activity:			
Building permits .... millions..	$57.0	$55.6	−2.5
Highway construction contracts awarded .... do....	$33.4	$28.2	−15.7
Cement shipments to the State..thousand 376-pound barrels..	975.7	958.1	−1.8
Farm marketing; cash receipts and government payments..millions..	$848.2	NA	--------
Mineral production .... do....	$97.5	$98.0	+.5

p Preliminary. r Revised. NA Not available.

Source: North Dakota Economic Development Commission, Bismarck, N. Dak. 58501; Bureau of Mines.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1967:								
Coal and peat	279	217	60	482	-------	9	18.69	469
Metal	7	26	(1)	1	-------	-------	-------	--------
Nonmetal	35	249	9	69	-------	4	57.71	519
Sand and gravel	618	159	98	933	1	15	17.15	6,677
Stone	119	196	28	187	-------	-------	-------	--------
Total [2]	1,058	181	191	1,672	1	28	17.34	3,881
1968: p								
Coal and peat	275	219	60	474	1	9	21.10	13,184
Metal	------	-------	-------	-------	-------	-------	-------	--------
Nonmetal	(3)	268	1	4	-------	-------	-------	--------
Sand and gravel	840	160	135	1,259	-------	23	18.26	390
Stone	95	170	16	129	-------	1	7.74	108
Total [2]	1,210	174	211	1,867	1	33	18.21	3,605

p Preliminary.
[1] Less than ½ unit.
[2] Data may not add to totals shown because of independent rounding.
[3] Less than 3.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Lignite).—Reaching a new high of 4.5 million tons, lignite output increased 8 percent over that of 1967. However, the production value, $8 million, was unchanged. Because of two idle operations during the year—Ecklund Taplin Coal Co. in Burleigh County and C. Nilles & Son Coal Co. in Morton County—the number of operating strip mines was reduced to 22. Four operators—Baukol-Noonan, Inc.; Knife River Coal Mining Co.; Lignite Division, The North American Coal Corp.; and Truax-Traer Coal Co. Division, Consolidation Coal Co., Inc.—produced over 94 percent of the State's coal.

Table 5.—Coal (lignite) sold or used,[1] by counties

County	1967		1968	
	Number of mines operating (all strip)	Short tons	Number of mines operating (all strip)	Short tons
Adams	1	16,236	1	11,355
Bowman	1	137,102	1	131,008
Burke	3	497,159	3	426,086
Burleigh	1	4,722	--------	--------
Grant	3	14,238	3	11,889
McLean	2	36,904	2	28,891
Mercer	3	2,876,309	3	3,318,947
Morton	3	12,998	2	10,720
Oliver	1	110,519	1	116,587
Stark	3	96,592	3	120,722
Ward	2	349,784	2	306,347
Williams	1	3,014	1	4,000
Total	24	4,155,522	22	4,486,502

[1] Excludes mines producing less than 1,000 short tons.

Consumption, mainly for power generation, is expected to increase as more generating capacity is required to meet expanding electrical demands. Construction continued on the 227-megawatt plant of Minnkota Power Co-Operative, Inc., near Center. The plant is scheduled for operation in 1970; Baukol-Noonan, Inc., is to supply lignite from a mine developed south of the plant site. Basin Electric Power Cooperative obtained financing for a 400-megawatt addition to its plant at Stanton; when completed, the addition will require an increase in output from the Glenharold mine operated by Truax-Traer Coal Co. The wheel-type excavator and the 100-ton trucks used at the Glenharold mine were replaced by a dragline and 50-ton trucks. The wheel-type excavator is to be used in Illinois.

Natural Gas.—Marketed natural gas increased slightly from 40.5 billion cubic feet in 1967 to 41.0 billion in 1968; the increase resulted from greater output of casinghead gas and the continued demand for this commodity. Output of dry natural gas continued to decline; the number of producing gas wells dropped from 31 in 1967 to 19 in 1968. Casinghead gas increased slightly, effecting an overall 1.4-percent increase in gas production. Again, none of the five discovery wells for the year was classed as a gas discovery. Three natural gas liquids plants removed liquids from the casinghead gas before it was sold to Montana-Dakota Utilities Co. Proved reserves of natural gas in the State declined by 15.3 billion to 866.8 billion cubic feet.[10]

Natural Gas Liquids.—Production of natural gas liquids was at approximately the same level as in 1967. A slight decline in unit value of LP gases lowered the output value of natural gas liquids approximately 4 percent. The three operating gasoline plants remained the same—Hunt Industries at North Tioga, Signal Oil and Gas Co. at Tioga, and Texaco Inc. at Lignite. The Signal and Texaco plants extracted sulfur from the processed gas.

Peat.—Peat Products Co. mined reed-sedge peat from bog deposits in Bottineau County and processed it for use as a soil conditioner. Although the quantity shipped in bulk increased over that shipped in 1967, packaged shipments declined.

Petroleum.—For the second successive year petroleum production declined; output was down 1 percent below the 1967 figure of 25.3 million barrels. The decline was caused by depletion of existing reservoirs and insufficient additions of new reserves. Demand for crude oil exceeded the State's supply; consequently, oil which had previously gone to the Minneapolis-St. Paul market area was diverted to North Dakota refineries.[11]

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[10] American Gas Association, Inc., American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada as of Dec. 31, 1968. V. 23, May 1969, p. 120.

[11] Folsom, Clarence B., Jr. North Dakota Crude Oil Inventory as of Jan. 1, 1969. North Dakota Geol. Survey, Misc. Ser., No. 38, 1969, p. 4.

Table 6.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1967	1968	Principal fields in 1968 in order of production
Billings	2,363	2,292	Fryburg, Medora, Rocky Ridge.
Bottineau	2,399	2,305	Newburg, South Westhope, Haas, Wiley, Nohall.
Bowman	711	643	Cedar Creek.
Burke	2,669	2,426	North Tioga, Rival, Black Slough, Northeast Foothills, Foothills.
Divide	328	293	North Tioga, Stoneview, Noonan.
Dunn	23	18	Lost Bridge.
McHenry	41	32	Pratt.
McKenzie	6,297	5,929	Antelope, Charlson, Blue Buttes, Hawkeye, Clear Creek.
Mountrail	959	1,004	Tioga, White Earth, East Tioga.
Renville	2,145	2,089	Sherwood, Glenburn, Mouse River Park.
Slope	107	88	Eleven Bar.
Stark	1,016	1,402	Dickinson, West Dickinson.
Ward	37	215	Lone Tree, Southwest Aurelia.
Williams	6,220	6,304	Beaver Lodge, Tioga, Capa, Grenora.
Total	25,315	25,040	

Source: North Dakota Geological Survey.

Table 7.—Oil and gas well drilling in 1968, by counties

County	Oil	Gas	Dry	Total	Footage
EXPLORATORY COMPLETIONS					
Billings	---	---	5	5	47,151
Bottineau	1	---	5	6	25,898
Bowman	---	---	24	24	126,248
Burke	---	---	5	5	33,582
Burleigh	---	---	1	1	7,308
Divide	---	---	6	6	40,447
Dunn	---	---	3	3	20,370
Golden Valley	---	---	6	6	56,075
McHenry	---	---	3	3	11,825
McKenzie	---	---	1	1	10,272
Mercer	---	---	1	1	5,250
Mountrail	---	---	1	1	7,909
Pierce	---	---	1	1	3,085
Renville	---	---	7	7	34,940
Rolette	---	---	1	1	2,985
Slope	---	---	36	36	192,716
Stark	1	---	3	4	30,267
Ward	2	---	6	8	43,200
Williams	1	---	1	2	22,929
Total	5	---	116	121	722,347
DEVELOPMENT COMPLETIONS					
Billings	2	---	---	2	18,726
Bottineau	2	---	5	7	26,570
Burke	11	---	4	15	97,878
Divide	---	---	1	1	7,050
McKenzie	---	---	1	1	8,945
Renville	17	---	5	22	108,412
Stark	5	---	---	5	40,055
Ward	2	---	1	3	19,397
Williams	5	---	1	6	55,314
Total	44	---	18	62	382,342
Grand total	49	---	134	183	1,104,689

Source: Committee on Statistics of Drilling, American Association of Petroleum Geologists.

At yearend 121 pools in 98 fields were producing oil. Of the 2,075 producing wells in these fields, 572 were classified as marginal. The North Dakota Geological Survey estimated[12] known primary- and secondary-recoverable oil reserves at 663.6 million barrels; representing revisions of pay thicknesses in several pools and deletions not offset by new discoveries, this figure was 7 percent below the estimated reserves for 1967. Most of the reserves (72.6 percent) were in formations of Mississippian age; 11.1 percent were in Devonian Formations; and 8.1 percent were in Ordovician sediments.

Two secondary recovery projects begun during the year brought the total of such projects to 24; net reserves added by these two projects were 844,000 barrels. Development drilling was concentrated in Burke and Renville Counties. Northeast Foothills field in Burke County had nine successful field wells out of 13 drilled. In Renville County, Glenburn field had nine wells drilled; six were successful. Mouse River Park field had eight successful wells in the Madison Formation (Mississippian).

Overall drilling increased 19.6 percent above the total of 153 wells drilled in 1967. Although development drilling declined 32 percent, exploratory drilling more than compensated by almost doubling the 1967 figure of 62 wells. The great increase in wildcat drilling reflected the high interest in the Muddy Formation (Cretaceous) aroused by development of the Bell Creek field in nearby Montana; more than half the wells were in the southwestern part of the State. In addition to the exploratory wells shown in table 7, 57 stratigraphic tests were drilled in eastern North Dakota.[13]

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[12] Page 2 of work cited in footnote 11.

Five discovery wells were drilled in 1968. One was a "new pool" discovery (Silurian) in the Tioga field; one was an extension later combined with the Landa field; and three were "new field" discoveries. Of the last, the Round Prairie field, Williams County, was probably most significant; the discovery well, Lamar Hunt, No. 1 Bank of North Dakota-Oyloe, SW¼ NE¼, sec 7, T 154 N, R 103 W, was completed for a flow-gage of 840 barrels of 43° API oil from the Winnipegosis Formation (Devonian)—the first Winnipegosis production in North Dakota—and 216 barrels of 47.5° API oil from the Red River Formation (Ordovician). In Stark County, Cardinal Petroleum Co. and others discovered the Zenith field when their NPRR No. 16–5 well, SE¼ SE¼, sec 5, T 139 N, R 98 W, was completed, flowing 500 barrels of oil per day from the Heath Formation (Mississippian). The East Goose Lake field, Divide County, was discovered by Signal Exploration, Inc. The discovery well, Kittelson No. 1, NE¼ SW¼, sec 35, T 162 N, R 103 W, was completed for a flow-gage of 63 barrels of oil per day from the Ratcliffe Formation (Mississippian).

NONMETALS

Clays.—Miscellaneous clays and shales were mined in Divide and Morton Counties. Baukol-Noonan, Inc., produced shale in both counties which was used for lightweight aggregate. Richter Construction Co. of Hebron mined clays in Morton County under a contract for Hebron Brick Co.

Lime.—Quicklime output, from the State's only producer, American Crystal Sugar Co., Drayton plant, increased 38 percent in quantity and 32 percent in value. The lime, produced from high-purity Michigan limestone, was used in its sugar refinery.

Salt.—Dakota Salt & Chemical Co. in Williams County produced salt by solution mining. Salt shipments increased 2 percent over those of 1967. Over one-half of the output was used in North Dakota; the remainder was used in Minnesota, Montana, and South Dakota. The livestock industry continued to be the largest single consumer. Other principal uses were ice removal, oil refining, and water softening.

Sand and Gravel.—Sand and gravel was produced in all 53 counties; Traill County had the greatest output, 1.2 million tons. Total output for the State increased 23 percent in quantity and 11 percent in value. The average value for all sand and gravel decreased 9 cents per ton below the 1967 average price of $1.03; however, the total value amounted to 10 percent of the State's total value of mineral production.

Shipments were from 359 operations, 19 less than in 1967. Of these, 210 were Government-and-contractor operations, accounting for 66 percent of the quantity and 57 percent of the value; 149 were commercial. Federal, State, county, and municipal highway construction and maintenance accounted for the greatest single use.

Stone.—The quantity and value of stone shipments declined 72 and 70 percent, respectively. This decrease was attributed mainly to two factors. First, in 1967 two U.S. Army Corps of Engineers projects and one North Dakota Water Commission program required a total of 185,000 tons of riprap. There were no such projects in 1968. Second, crushed stone used by contractors for the North Dakota State Highway Department was only 88,000 tons, compared with 359,000 tons in 1967.

Sulfur.—Natural gas processing plants operated by Texaco Inc., in Burke County, and by Signal Oil and Gas Co., in Williams County, recovered elemental sulfur as a byproduct. The value of sulfur shipments increased 9 percent. This commodity is not included in the total value of mineral production of North Dakota (table 1).

Vermiculite.—Vermiculite shipped from outside North Dakota was exfoliated by Robinson Insulation Co. at Minot. Besides its primary use for building insulation, other uses included plaster and concrete aggregates, poultry litter, and soil conditioner.

METALS

Molybdenum.—A concentrate of ammonium tetramolybdate was recovered as a byproduct from processing stockpiled uranium ore. However, no shipments were made.

Uranium.—Uranium shipments, all from stockpile, decreased 36 percent in quantity and 37 percent in value. No uranium ore was mined in 1968.

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[13] Stratigraphic tests are drilled for geologic information only, do not require formal drilling permits, and therefore are not listed in formal drilling tabulations.

Table 8.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	349	$415	355	$423
Paving	565	621	206	189
Fill	142	138	166	179
Other	1	1	2	3
Total	1,057	1,175	729	794
Gravel:				
Construction:				
Building	333	647	441	899
Paving	2,520	2,600	2,131	2,375
Railroad ballast	111	46	174	59
Fill	101	72	126	98
Miscellaneous	41	46	60	66
Total	3,106	3,411	2,932	3,497
Total sand and gravel	4,163	4,586	3,661	4,291
Government-and-contractor operations:				
Sand:				
Paving	1,595	1,577	3,314	3,039
Fill	--------	--------	5	5
Total	1,595	1,577	3,319	3,044
Gravel:				
Building	--------	--------	28	28
Paving	3,064	2,955	3,830	2,795
Fill	--------	--------	1	1
Total	3,064	2,955	3,859	2,824
Total sand and gravel	4,659	[1] 4,532	7,178	[1] 5,868
All operations:				
Sand	2,652	2,752	4,048	3,838
Gravel	6,170	6,366	6,791	6,321
Total	8,822	9,118	10,839	10,159

[1] Final figure, supersedes figure given in commodity chapter.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Baukol-Noonan, Inc	Noonan, N. Dak. 58765	Open pit mine and expanding plant.	Divide.
		----do	Morton.
Hebron Brick Co	Hebron, N. Dak. 58638	Open pit mine	Do.
Coal:			
Baukol-Noonan, Inc	Noonan, N. Dak. 58765	Strip mine; thermal drying, crushing, and oil treatment plant.	Burke.
Consolidation Coal Co., Truax-Traer Coal Co. Division.	111 N. Wabash Ave. Chicago, Ill. 60602	Strip mine, crushing and oil treatment plant.	Do.
		----do	Mercer, Oliver.
		Strip mine; thermal drying, crushing, and oil treatment plant.	Ward.
Knife River Coal Mining Co	Bismarck, N. Dak. 58501	Strip mine, crushing and oil treatment plant.	Bowman.
		Strip mine, crushing and wax oil treatment plant.	Mercer.

See footnote at end of table.

Table 9.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal—Continued			
The North American Coal Corp., Lignite Division.	12800 Shaker Blvd. Cleveland, Ohio 44120	Strip mine, crushing and oil treatment plant.	Do.
Lime: American Crystal Sugar Co.	600 Boston Bldg. Denver, Colo. 80202	Shaft kiln at beet sugar refinery.	Pembina.
Natural gas and petroleum:[1]			
Amerada Petroleum Corp.	Box 2040 Tulsa, Okla. 74101	Crude oil wells: Fryburg field.	Billings.
		Crude oil wells: Antelope, Blue Buttes, and Charlson fields.	McKenzie.
		Crude oil wells: Beaver Lodge field.	Williams.
American Oil Co.	Box 6610–A Chicago, Ill. 60680	Refinery	Morton.
California Oil Co. (Chevron Oil Co.), Western Division.	Box 599, 1700 Broadway Denver, Colo. 80201	Crude oil wells: Glenburn field.	Renville.
Cardinal Petroleum Co.	411 Medical Arts Bldg. Billings, Mont. 59101	Crude oil wells: South Westhope field.	Bottineau.
Chandler & Associates (Chandler-Simpson, Inc.)	1401 Denver Club Bldg. Denver, Colo. 80202	Crude oil wells: Sherwood field.	Renville.
Continental Oil Co.	1300 Main Street Houston, Tex. 77001	Crude oil wells: West Dickinson field.	Stark.
Hunt Oil Co. (Hunt Industries).	1401 Elm Dallas, Tex. 75202	Crude oil wells: North Tioga field and gas processing plant.	Burke.
Marathon Oil Co.	539 S. Main Street Findley, Ohio 45840	Crude oil wells: Glenburn field.	Renville.
Monsanto Co., Hydrocarbons & Polymers Division.	800 N. Lindbergh Blvd. St. Louis, Mo. 63116	Crude oil wells: Black Slough field.	Burke.
		Crude oil wells: Glenburn and Sherwood fields.	Renville.
Pan American Petroleum Corp.	Box 591 Tulsa, Okla. 74101	Crude oil wells: Black Slough and Rival fields.	Burke.
Petroleum, Inc.	800 W. Douglas Wichita, Kans. 67202	Crude oil wells: Sherwood field.	Renville.
Placid Oil Co.	Beck Bldg. Shreveport, La. 71101	----do	Do.
Shell Oil Co.	50 W. 50th Street New York, N.Y. 10020	Crude oil wells: Cedar Creek field.	McKenzie.
Skelly Oil Co.	Box 1650 Tulsa, Okla. 74101	Crude oil wells: Clear Creek field.	McKenzie.
Superior Oil Co.	First City National Bank Bldg. Houston, Tex. 77002	Crude oil wells: Medora field.	Billings.
Tenneco Oil Co.	Box 2511 Houston, Tex. 77051	Crude oil wells: Glenburn field.	Renville.
Texaco Inc.	Box 52332 Houston, Tex. 77052	Crude oil wells: Blue Buttes and Charlson fields.	McKenzie.
		Gas processing plant	Burke.
Texota Oil Co.	477 San Jacinto Bldg. Houston, Tex. 77002	Crude oil wells: Glenburn field.	Bottineau.
Union Oil Company of California.	Box 7600 Los Angeles, Calif. 90055	Crude oil wells: Sherwood field.	Renville.
Union Texas Petroleum Corp.	Box 2120 Houston, Tex. 77001	Crude oil wells: Black Slough field.	Burke.
		Crude oil wells: Glenburn field.	Renville.
Westland Oil Co.	Williston, N. Dak. 58801	Refinery	Williams.
Peat: Peat Products Co.	821 4th Street Bismarck, N. Dak. 58501	Bog	Bottineau.
Salt: Dakota Salt & Chemical Co.	General Carbon Bldg. West Haven Road Lawrenceville, Ill. 62439	Well and plant	Williams.
Sand and gravel:			
Badinger Sand & Gravel	Dickinson, N. Dak. 58601.	4 pits and plants	Stark.
Ehley & Frisch Gravel Co.	Ashley, N. Dak. 58413	10 pits and plant	Emmons.
		----do	McIntosh.
Northern Improvement Co.	Box 2025 Fargo, N. Dak. 58102	2 pits and plant	Bottineau.
		3 pits and 2 plants	Burleigh.
		3 pits	McHenry.
		Pit and plant	Oliver.
		----do	Pembina.
		3 pits and plant	Stark.
		Pit and plant	Wells.
Sheyenne Sand & Gravel, Inc.	Box 178 Sheyenne, N. Dak. 58374	----do	Eddy.
Stone:			
La Moure County Highway Dept.	LaMoure, N. Dak. 58458	Quarry and plant	LaMoure.
McKenzie County Highway Dept.	Watford City, N. Dak. 58854.	----do	McKenzie.
Wm. Collins & Sons, Inc.	Box 1939 Fargo, N. Dak. 58103	----do	Bowman.
Uranium: Union Carbide Corp., Mining and Metals Division.	270 Park Avenue New York, N.Y. 10017	Open pit mine and burning plant.	Stark.

[1] Principal producers in the major fields.

The Mineral Industry of Ohio

By Joseph Krickich[1]

Ohio's mineral industry output, continuing an upward trend started in 1962, was valued at $536.9 million, an increase of 8 percent. Modest to substantial increases in nearly every major mineral product, except gypsum, helped set this record. New high levels of output were established for bituminous coal, salt, and sand and gravel. Accelerated building and highway construction activity were major contributing factors with demand for aggregate materials at record levels.

With the exception of Fulton County, mineral production was reported in all of the State's 88 counties. Belmont and Harrison Counties, with mineral output values of $50.8 million and nearly $45 million, respectively, were the foremost mineral-producing areas. Fifteen other counties had values in excess of $10 million.

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[1] Supervisory mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Ohio[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland ... thousand 376-pound barrels	14,726	$46,860	15,222	$49,814
Masonry ... thousand 280-pound barrels	946	2,730	1,063	3,155
Clays ... thousand short tons	4,670	15,185	4,750	15,216
Coal (bituminous) ... do	46,014	176,921	48,323	191,427
Gem stones	NA	3	NA	3
Lime ... thousand short tons	3,636	48,817	3,701	49,367
Natural gas ... million cubic feet	41,315	9,957	42,673	10,540
Peat ... short tons	7,301	100	6,506	94
Petroleum (crude) ... thousand 42-gallon barrels	9,924	31,427	11,204	35,722
Salt ... thousand short tons	5,407	39,549	5,713	43,172
Sand and gravel ... do	43,196	52,888	46,734	57,671
Stone ... do	45,458	72,534	[2] 48,054	[2] 78,772
Value of items that cannot be disclosed: Abrasive stone, gypsum, and dimension limestone and dolomite (1968)	XX	1,917	XX	1,945
Total	XX	498,888	XX	536,898
Total 1957–59 constant dollars	XX	501,350	XX	p 525,341

p Preliminary. NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes dimension limestone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Ohio, by counties [1] [2]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Adams	$1,282	$1,378	Stone.
Allen	1,529	W	Stone, sand and gravel.
Ashland	271	258	Sand and gravel, clays.
Ashtabula	W	W	Lime, sand and gravel.
Athens	1,933	1,732	Coal, stone, sand and gravel, clays.
Auglaize	W	W	Sand and gravel, stone, clays.
Belmont	43,470	50,790	Coal, stone.
Brown	W	W	Sand and gravel, stone.
Butler	3,341	3,302	Sand and gravel.
Carroll	1,636	W	Coal, clays, sand and gravel.
Champaign	W	W	Sand and gravel, peat.
Clark	W	W	Sand and gravel, lime, stone.
Clermont	-------	5	Sand and gravel.
Clinton	W	W	Stone, sand and gravel.
Columbiana	W	W	Coal, clays, sand and gravel.
Coshocton	W	W	Coal, stone, sand and gravel, clays.
Crawford	W	W	Stone, sand and gravel.
Cuyahoga	W	W	Salt, lime, sand and gravel, clays, peat.
Darke	W	W	Sand and gravel, clays, peat.
Defiance	W	W	Sand and gravel.
Delaware	2,358	2,471	Stone, lime, clays.
Erie	4,108	6,982	Stone, lime, sand and gravel.
Fairfield	W	W	Sand and gravel.
Fayette	742	1,124	Stone.
Franklin	W	W	Sand and gravel, stone, lime, clays, peat.
Gallia	1,111	1,072	Stone, coal, sand and gravel.
Geauga	W	W	Sand and gravel, stone.
Greene	W	W	Cement, stone, sand and gravel, clays.
Guernsey	5,263	1,642	Coal, stone.
Hamilton	4,751	4,938	Sand and gravel, stone.
Hancock	969	1,231	Stone, lime, clays.
Hardin	W	W	Stone.
Harrison	45,133	44,956	Coal, stone, clays.
Henry	W	117	Sand and gravel, clays.
Highland	W	W	Stone, sand and gravel, clays.
Hocking	354	683	Coal, sand and gravel, clays, stone.
Holmes	1,678	1,696	Coal, clays, stone, sand and gravel.
Huron	149	214	Sand and gravel, stone, peat.
Jackson	4,956	4,894	Coal, clays, stone, sand and gravel.
Jefferson	18,526	W	Coal, clays.
Knox	2,046	W	Sand and gravel, stone.
Lake	W	W	Salt, lime, sand and gravel, stone.
Lawrence	8,268	9,584	Cement, coal, clays, stone, sand and gravel.
Licking	W	W	Sand and gravel, clays.
Logan	638	616	Stone, sand and gravel, peat.
Lorain	W	W	Stone, sand and gravel, abrasives.
Lucas	W	W	Cement, stone, sand and gravel, clays.
Madison	W	594	Stone, sand and gravel.
Mahoning	W	7,545	Stone, coal, clays, peat.
Marion	1,663	2,416	Stone, sand and gravel, clays.
Medina	W	W	Sand and gravel, clays.
Meigs	W	1,871	Sand and gravel, coal, stone, salt.
Mercer	W	W	Stone.
Miami	W	W	Stone, sand and gravel.
Monroe	W	W	Coal, sand and gravel, stone.
Montgomery	W	4,297	Sand and gravel, stone.
Morgan	W	3,681	Coal, sand and gravel, stone.
Morrow	54	49	Sand and gravel.
Muskingum	W	W	Coal, cement, stone, sand and gravel, clays.
Noble	W	8,629	Coal, stone, clays.
Ottawa	8,166	8,977	Stone, lime, gypsum, sand and gravel.
Paulding	W	W	Cement, stone, clays.
Perry	W	W	Coal, sand and gravel, stone, clays.
Pickaway	W	W	Sand and gravel, stone.
Pike	W	925	Do.
Portage	3,577	W	Sand and gravel, peat.
Preble	W	W	Lime, stone, sand and gravel.
Putnam	583	512	Stone, lime, clays, sand and gravel.
Richland	W	W	Sand and gravel, clays, peat.
Ross	W	W	Sand and gravel, stone.
Sandusky	24,313	23,205	Lime, stone, sand and gravel.
Scioto	2,291	2,654	Stone, sand and gravel, clays.
Seneca	W	W	Lime, stone, clays.
Shelby	464	W	Sand and gravel, stone.
Stark	11,968	12,735	Cement, sand and gravel, stone, coal, clays, peat.
Summit	W	W	Salt, lime, stone, cement, sand and gravel, clays.
Trumbull	W	W	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Ohio, by counties [1] [2]—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Tuscarawas	$15,435	$15,618	Coal, clays, sand and gravel, stone.
Union	W	W	Stone, sand and gravel.
Van Wert	620	844	Stone, clays.
Vinton	1,056	W	Coal, stone, clays.
Warren	1,437	1,711	Sand and gravel.
Washington	W	W	Sand and gravel, coal.
Wayne	W	W	Salt, sand and gravel, stone, clays, coal.
Williams	227	W	Sand and gravel.
Wood	2,114	2,364	Stone.
Wyandot	W	W	Stone, lime, sand and gravel, clays, peat.
Undistributed [3]	270,408	298,586	
Total	498,888	536,898	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Fulton County is not listed because no production was reported.

[2] Natural gas and petroleum values are not listed by counties as data are not available; included with "Undistributed."

[3] Includes natural gas, petroleum, gem stones, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

Table 3.—Indicators of Ohio business activity

		1967	1968 p	Change (percent)
Employment and labor force, annual average: [1]				
Total labor force	thousands	4,236.8	4,349.2	+2.7
Unemployment	percent of work force	3.2	2.9	—9.4
Employment:				
Manufacturing	thousands	1,398.8	1,429.9	+2.2
Durable goods	do	996.6	1,018.8	+2.2
Stone, clay, and glass products	do	68.0	69.3	+1.9
Primary metal industries	do	177.8	179.5	+1.0
Fabricated metal products	do	153.2	157.0	+2.5
Machinery, except electrical	do	224.9	222.1	—1.2
Electrical equipment	do	146.2	148.8	+1.8
Transportation equipment	do	152.2	164.9	+8.3
Instruments and related products	do	15.6	16.3	+4.5
Nondurable goods	do	402.2	411.1	+2.2
Nonmanufacturing	do	2,221.0	2,323.6	+4.6
Mining	do	19.1	19.3	+1.0
Contract construction	do	155.9	167.4	+7.4
Payroll average weekly earnings: [1]				
Manufacturing		$132.48	$142.58	+7.6
Durable goods		$135.11	$146.09	+8.1
Nondurable goods		$125.14	$132.99	+6.3
Personal income: [2]				
Total	millions	$33,605	$36,918	+9.9
Per capita		$3,204	$3,487	+8.8
Construction activity: [3]				
New housing units authorized		59,299	65,232	+10.0
Cement shipments into and within Ohio	thousand 376-pound barrels	18,484	19,972	+8.1
Mineral production	thousands	$498,888	$536,898	+7.6

p Preliminary.

[1] Source: Division of Research and Statistics, Ohio, Bureau of Employment Services.

[2] Source: Survey of Current Business, U.S. Department of Commerce.

[3] Source: Construction Reports, U.S. Department of Commerce.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1967:								
Coal	7,432	249	1,849	14,846	4	400	27.21	2,823
Peat	18	131	2	15	-------	-------	-------	-------
Nonmetal	2,571	265	682	5,439	-------	132	24.27	577
Sand and gravel	2,361	231	546	4,560	4	62	14.48	5,796
Stone	5,504	271	1,493	12,095	1	168	13.97	1,268
Total [1]	17,886	256	4,572	36,954	9	762	20.86	2,349
1968: [p]								
Coal	7,700	244	1,887	15,020	13	435	29.95	6,501
Peat	16	116	2	12	-------	-------	-------	-------
Nonmetal	2,250	268	608	4,840	1	109	22.73	1,686
Sand and gravel	2,305	240	553	4,611	2	76	16.91	3,037
Stone	5,470	275	1,504	12,261	7	190	16.07	4,003
Total [1]	17,775	256	4,553	36,748	23	810	22.72	4,597

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

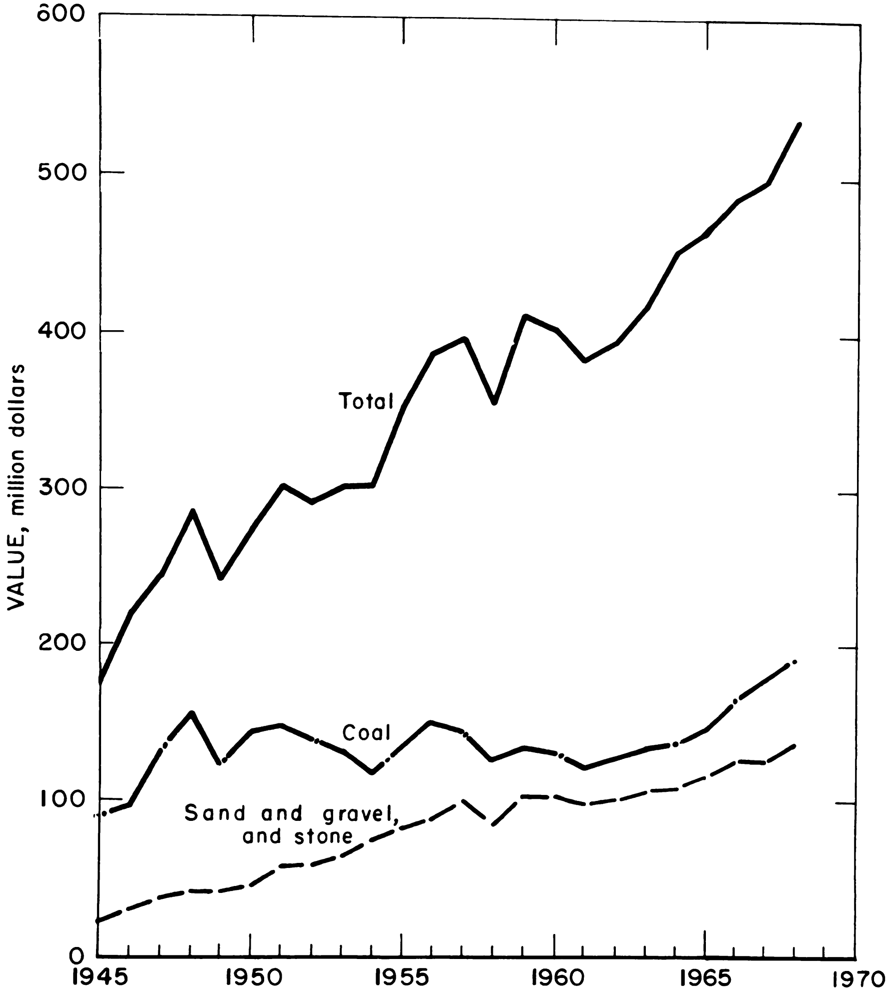

Figure 1.—Value of coal, sand and gravel, and stone, and total value of mineral production in Ohio.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Stones.—Production of abrasive stone (grindstone) continued to decline. Output was from one operation in Lorain County as a byproduct of sandstone quarrying at Amherst.

Cement.—Production, shipments, and value of portland and masonry cement increased compared with that of 1967. Shipments of portland cement increased 3 percent. The average value per barrel of portland cement rose from $3.18 in 1967 to $3.27; average value of masonry cement increased $0.08 to $2.97. Companies continued to operate at 75 percent of capacity. Yearend stocks were 458,000 barrels lower than at the end of 1967. In terms of value of shipments, Greene, Paulding, and Muskingum were the leading cement-producing counties. Apparent cement consumption in the State totaled 20.0 million barrels of portland cement and 1.6 million barrels of masonry cement. Ohio cement producers supplied 52 percent of the portland and 47 percent of the masonry cement consumed. In addition to supplying consumers in Ohio, cement producers made shipments into other States. Of the total cement shipments, 9 percent of the portland cement and 5 percent of the masonry cement went to Michigan. Indiana received approximately 8 percent of the portland cement and 11 percent of the masonry shipments, and West Virginia 8 percent of the portland and 8 percent of the masonry cement. Lesser quantities of both types of cement were shipped into Kentucky, western Pennsylvania, and Virginia.

Distribution of portland cement shipments by types of customers was as follows: Ready-mix concrete companies, 9.3 million barrels; concrete product manufacturers, 2.6 million barrels; and highway and other contractors 2.5 million barrels. The remainder went to building material dealers and miscellaneous customers. Over 12.7 million barrels of portland cement was shipped by truck and the remainder was shipped by rail, or consumed at the plants. Bulk shipments predominated; only 7 percent was shipped in containers, mainly paper bags. Cement companies used over 4 million tons of limestone and cement rock, 592,000 tons of clay and shale, 126,000 tons of gypsum, and 91,000 tons of sand as primary raw materials. Quantities of iron ore and mill scale were also used. Fuel consumed in producing portland cement was predominately bituminous coal but quantities of natural gas and fuel oil also were consumed. Producers used 391.1 million kilowatt-hours of electrical energy, of which 27 percent was generated by the producer and 73 was purchased from public utility companies.

Portland cement was produced at five plants using the wet process and four plants using the dry process. The largest kiln operation in the four plants using the dry process was 425 feet long. Three 450-foot-long kilns were in operation in plants using the wet process. A total of 28 kilns, ranging in size from 100 to 450 feet in length, were in operation during the year.

Clays.—Total clay production (fire clay and miscellaneous clay and shale) increased 2 percent above that of 1967. Of the total, 58 percent was miscellaneous clay or shale used chiefly for manufacturing heavy clay products and the remainder was fire clay used mainly in refractories and heavy clay products. Clays used in manufacturing heavy clay products (mainly building brick) was below that of 1967. Clay output for refractories was virtually unchanged at 831,000 tons; clay used for manufacturing cement increased by 70,000 tons to 714,000 tons. Production of clay and shale used for manufacturing lightweight aggregate and floor and wall tile was greater than that of 1967. Other uses of Ohio clay included pottery and stoneware and as rotary drilling mud. Of the 15 fire clay-producing counties, Tuscarawas, Columbiana, Stark, and Jackson Counties were the leading areas, accounting for 75 percent of the fire clay tonnage. Among the 36 miscellaneous clay and shale producing areas, Tuscarawas, Cuyahoga, Stark, and Greene Counties led in production. H. K. Porter Co., Inc., Refractories Division, was awarded a Certificate of Achievement in Safety for its Pleasant Valley mine for working without any lost time injuries. In 1968, over 51,000 man-hours were worked at the underground mine.

Table 5.—Finished portland cement produced, shipped, and in stock

(Thousand barrels and thousand dollars)

Year	Number of active plants	Production	Shipments from mills		Stocks at mills Dec. 31
			Quantity	Value	
1964	10	15,606	15,553	$50,647	2,079
1965	9	14,599	14,786	47,499	1,600
1966	9	15,755	15,181	48,740	2,271
1967	9	14,773	14,726	46,860	2,224
1968	9	14,891	15,222	49,814	1,766

Gem Stones.—Gem and mineral specimens were recovered from mines and quarries throughout the State mostly by members of mineral and lapidary clubs. Specimens collected included calcite, celestite, flint, and jasper. Value was the same as that of 1967. Flint, the State's official gem stone, was recovered chiefly at Flint Ridge in southeastern Licking County and the adjacent area of Muskingum County.

Graphite (Synthetic).—The Ohio Carbon Co. at Cleveland produced quantities of synthetic graphite from petroleum coke. Output was shaped for use in electrical motor brushes.

Gypsum.—Production and value of crude gypsum declined for the second consecutive year. A slight increase in average unit price was reported. Output from one underground mine and one open pit in Ottawa County was calcined at nearby plants for use in manufacturing building products. National Gypsum Co. at Lorain also calcined gypsum from crude material shipped from outside the State.

Lime.—Output of lime resumed its upward trend as production increased 2 percent above that of 1967. Increased demand for chemical and industrial lime offset declines reported for agricultural, building, and refractory lime. The average unit price for all major uses, except refractory lime, increased. Ohio continued as the leading lime-producing State, accounting for 20 percent of the National output. Fifty-nine percent of the total lime production was captive tonnage or was marketed in Ohio. Other leading areas for Ohio lime were Pennsylvania (324,000 tons), Michigan (205,000 tons), Indiana (191,000 tons), West Virginia (177,000 tons), New York (159,000 tons), and Illinois (125,000 tons). Quantities also were exported to Canada and other countries. Quicklime manufacture was predominately by means of shaft-type kilns. Hydrated lime producers used both batch and continuous hydrators. Fuels used by producers included bituminous coal, coke, natural gas, and fuel oil. Sandusky County continued as the leading area for lime production accounting for 1.1 million tons valued at $16 million.

Perlite (Expanded).—Expanded perlite was produced at four plants, one each in Cuyahoga, Hamilton, Lorain, and Ottawa Counties. Crude perlite shipped from Western States was processed chiefly for plaster and concrete aggregate, insulation, and soil conditioning. Production and value were below that of 1967.

Salt.—A new record high tonnage of salt was established as output increased 6 percent above that of 1967 and marked the 10th consecutive year for increasing salt production. Value increased by $3.6 million to $43.2 million. Production of rock and evaporated salt as well as brine was greater than that in the previous year. Rock salt recovered from underground mines in Cuyahoga and Lake Counties was sold mainly for controlling icy highways and in chemical applications. Evaporated salt produced in Cuyahoga, Meigs, Summit, and Wayne Counties was sold for a wide variety of uses; some was marketed as pressed block. Producers used both vacuum-pan and open-pan processes for recovering the salt. Brine production in Lake and Summit Counties was primarily captive tonnage used for manufacturing chlorine and soda ash. As in previous years, Lake

Table 6.—Lime sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Year	Agricultural		Building		Chemical and other industrial		Refractory		Total[1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1964	23	$352	374	$7,561	2,147	$26,209	1,120	$19,186	3,664	$53,308
1965	27	410	327	6,425	2,387	27,905	1,090	18,468	3,831	53,208
1966	17	253	299	5,490	2,574	28,740	968	16,514	3,858	50,997
1967	16	234	257	5,672	2,550	28,548	812	14,364	3,636	48,817
1968	14	221	245	5,464	2,633	29,833	810	13,848	3,701	49,367

[1] Data may not add to totals shown because of independent rounding.

County with two operations, was a leading area for salt production. Ohio continued as a leading area for salt production, ranking third in national output.

Sand and Gravel.—Production of sand and gravel increased 8 percent above that of 1967, setting a new high record. Value was 9 percent higher and totaled $57.7 million. Output was 2.9 million tons above that of the previous high year, 1966. The increase was attributed mainly to greater demand for structural and paving material. Commercial sand and gravel used in building and highway construction totaled 39.8 million tons, 4.3 million tons greater than in 1967. Production of industrial sand declined but value was greater due to higher unit values. Industrial sand output totaled nearly 1.3 million tons valued at $5.6 million; average value increased from $4.12 per ton in 1967 to $4.31. Most of the industrial sand was marketed for molding, glass manufacturing, and furnace construction and repair.

Sand and gravel was produced in 70 counties, two more than in 1967. Franklin, Hamilton, Montgomery, Butler, and Portage Counties, each with output in excess of 2 million tons, were the leading areas. In addition, seven other counties had production exceeding 1 million tons. Commercial producers processed 86 percent of the total tonnage by washing, screening, sizing, or crushing. Over 44.2 million tons of sand and gravel was shipped to consumers by truck and the remainder by rail or water. The number of commercial operations totaled 431. Of the total, 158

Table 7.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	7,058	$8,020	7,061	$8,446
Paving	8,149	8,732	9,520	9,797
Fill	1,413	929	1,478	1,141
Molding	475	2,093	432	2,017
Fire or furnace	138	423	W	W
Other [1]	1,081	3,342	1,226	3,873
Total	18,314	23,539	19,717	25,274
Gravel:				
Building	7,357	8,882	8,301	10,141
Paving	12,959	16,478	14,930	19,412
Fill	2,035	1,182	2,163	1,362
Other [2]	2,152	2,662	1,051	1,215
Total	24,503	29,204	26,445	32,130
Total sand and gravel	42,817	52,743	46,162	57,404
Government-and-contractor operations:				
Sand:				
Paving	175	62	198	$70
Fill	--------	--------	26	9
Total	175	62	224	$79
Gravel:				
Paving	127	46	235	141
Fill	77	37	[3] 113	[3] 47
Total	204	83	348	188
Total sand and gravel	379	145	572	267
All operations:				
Sand	18,489	23,601	19,941	25,353
Gravel	24,707	29,287	26,793	32,318
Total	43,196	52,888	46,734	57,671

W Withheld to avoid disclosing individual company confidential data.

[1] Includes fire or furnace sand (1968), glass, blast, engine, filtration, ground, and other sands.

[2] Includes railroad ballast, miscellaneous, and other gravel.

[3] Includes other gravel.

Table 8.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1967		1968	
	Quantity	Value	Quantity	Value
Allen	100	$142	W	W
Ashtabula	135	177	111	$126
Auglaize	348	379	343	429
Butler	2,942	3,341	2,881	3,302
Carroll	20	23	W	W
Clark	1,286	1,310	1,181	1,201
Clermont	---	---	5	5
Clinton	61	56	53	49
Columbiana	118	160	232	205
Coshocton	943	972	695	768
Crawford	W	W	90	125
Cuyahoga	658	779	652	816
Erie	135	342	W	W
Franklin	5,254	6,142	6,266	7,564
Geauga	780	1,228	1,044	1,593
Greene	916	897	993	1,118
Hamilton	4,025	4,740	4,484	4,932
Henry	71	92	W	W
Huron	144	127	W	W
Jackson	2	5	3	3
Knox	815	2,046	914	2,245
Lake	236	247	274	343
Lawrence	169	181	W	W
Licking	1,139	1,072	857	906
Logan	125	161	131	152
Lorain	518	730	W	W
Lucas	554	371	713	613
Madison	173	191	W	W
Marion	262	237	307	262
Medina	623	711	685	803
Miami	654	719	863	965
Montgomery	2,924	3,240	3,350	3,178
Morrow	55	54	49	49
Muskingum	676	W	W	W
Portage	2,401	3,446	2,717	3,891
Preble	155	183	150	156
Putnam	20	20	20	14
Richland	509	545	652	680
Ross	702	671	775	738
Shelby	339	371	405	444
Stark	1,600	2,180	1,669	2,462
Summit	1,422	1,266	1,456	1,300
Tuscarawas	1,331	1,772	1,451	2,031
Union	227	151	198	153
Warren	1,221	1,437	1,487	1,711
Washington	436	452	459	530
Wayne	447	560	555	683
Williams	227	227	W	W
Wyandot	223	226	363	341
Undistributed [1]	5,075	8,509	7,201	10,785
Total	43,196	52,888	46,734	57,671

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes Ashland, Athens, Brown, Champaign, Darke, Defiance, Fairfield, Gallia, Highland, Hocking, Holmes, Meigs, Monroe, Morgan, Ottawa (1968), Perry, Pickaway, Pike, Sandusky, Scioto, and Trumbull Counties, some sand and gravel unspecified by county, and data indicated by symbol W.

operations produced less than 25,000 tons and accounted for 3 percent of the commercial tonnage. Two operators had output exceeding 1 million tons and nine operations produced from 500,000 to 1 million tons.

Slag (Iron-Blast-Furnace).—Production of iron-blast-furnace slag was nearly 6 million tons valued at $11.6 million, according to the National Slag Association. Output was 2 percent above that of 1967; average unit price increased from $1.74 per ton to $1.93, well above the National average of $1.72. Seventy percent of the total processed slag was screened air-cooled materials; the remainder consisted of granulated and lightweight (expanded) slag. The air-cooled slag was used chiefly as aggregate for concrete and bituminous construction, highway and airport construction, and as railroad ballast. Most of the granulated slag was used in highway construction and for manufacturing hydraulic cement. The chief use for expanded slag was as a lightweight aggregate in concrete masonry blocks and in lightweight concrete. The State continued to rank second in production of processed slag accounting for 21 percent of the national output. Processing plants were centered mainly near steelmaking facilities in Cleveland, Middletown, and Youngstown.

Stone.—Output of stone increased for the fourth consecutive year, reflecting the continuing high level of activity in all phases of highway and building construction. Greater demand for crushed limestone (including dolomite) used as aggregate was the major contributing factor for the increase. Production of crushed limestone was 6 percent above that of 1967 and accounted for most of the State's total stone output. Miscellaneous uses of crushed limestone included whiting, filter beds, stone sand, paper, glass and alkali manufacture, filler, and for dust abatement in coal mines. Dimension limestone (including dolomite) production used mainly as dressed architectural stone was below that of 1967 but value was higher. Output was from quarries in Miami and Seneca Counties. Of the 57 limestone-producing counties (one more than in 1967) Sandusky County continued as the leading area with output of 4.2 million tons. Erie, Wyandot, and Mahoning Counties also were important limestone-producing areas.

Dimension sandstone (including quartzite) production declined but value was greater due to higher unit prices. Output was 115,000 tons valued at nearly $5 million compared with 126,000 tons and $4.7 million in 1967. Most of the sandstone was fabricated for architectural applications but quantities also were sold for steel furnace linings, construction, curbing, and flagging. Crushed and broken sandstone (including quartzite) production totaled 786,0000 tons valued at $2.3 million, an increase of 6 and 4 percent, respectively. The stone was marketed mainly for aggregate, riprap, refractories (ganister), and glass manufacturing. Sandstone was quarried in 16 counties; Lorain, Scioto, and Coshocton Counties were the leading areas for dimension stone and Geauga, Lorain, and Ross Counties for crushed stone. In the Quarry Group of National Safety Competition, John W. Karch Stone Co., National Lime & Stone Co., and Basic Refractories were awarded Certificates of Achievement in Safety for their safety records.

Sulfur.—Production and shipments of elemental sulfur recovered at the Toledo Refinery of Sun Oil Co. were below that of 1967 but value was higher owing to a 44-percent increase in the average unit price. Sulfur was recovered by the catalytic oxidation of hydrogen sulfide.

Vermiculite (Exfoliated).—The Cleveland Gypsum Co., Division of Cleveland Builders Supply Company, processed crude vermiculite shipped from out-of-State at its Cleveland plant. Production and sales were below that of 1967. The exfoliated

Table 9.—Crushed and broken limestone and dolomite sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967		1968	
	Quantity	Value	Quantity	Value
Riprap	455	$545	306	$496
Aggregate [1]	26,211	35,014	29,065	40,766
Fluxing stone	4,416	6,352	4,061	5,812
Agriculture	2,170	3,765	1,885	3,586
Railroad ballast	945	1,176	962	1,221
Cement	4,379	6,218	4,896	6,733
Lime	5,002	9,593	3,025	6,740
Miscellaneous uses	1,007	2,938	2,953	6,138
Total [2]	44,584	65,602	47,153	71,493

[1] Includes dense graded road base stone and concrete, bituminous, macadam, and surface treatment aggregates.

[2] Data may not add to totals shown because of independent rounding.

vermiculite was sold for plaster and concrete aggregate and horticultural and other applications.

MINERAL FUELS

Coal (Bituminous).—A new record high production of bituminous coal was reached as output totaled 48.3 million tons valued at $191.4 million. Coal tonnage increased for the seventh consecutive year and was 5 percent above the previous high year 1967. Strip mines supplied 63 percent of the total tonnage; 34 percent came from underground mines and 3 percent from auger mines. The average value per ton of coal also increased, $3.96 per ton compared with $3.84 in 1967. The total number of active mines producing 1,000 tons or more decreased from 401 in 1967 to 372. Underground mines decreased by 12 to a total of 55; strip mines declined by 10 and auger mines by seven. Production was reported in 25 counties; Belmont and Harrison Counties with 12.6 and 10.5 million tons, respectively, were the leading areas.

Coal recovered from underground mines increased from 15.2 million tons to 16.3 million tons; average value per ton was $4.46 compared with $4.39 in 1967. Of the 15 counties with output from underground mines, Belmont and Harrison Counties accounted for over half of the tonnage. The number of continuous mining machines used at underground mines increased from 66 to 75, reflecting a continuing trend for greater mechanization. Over 9.4 million tons of coal was mined and loaded by continuous mining machines compared with 8.5 million tons in the previous year. Seventy-eight percent of the tonnage mined by continuous mining machines was loaded into shuttle cars and the remainder went on to conveyors. Production of coal recovered from auger mines declined 10 percent from that of 1967 and totaled 1.5 million tons valued at $5 million. Average unit price was only slightly higher, increasing from $3.38 per ton to $3.39. Noble County was the leading area for auger-mined coal with an output of 356,000 tons. Other leading areas having tonnages in excess of 200,000 tons were Columbiana, Jefferson, and Tuscarawas Counties.

Strip-mined tonnage was 1.3 million tons above that of 1967 and totaled 30.5 million tons valued at $113.6 million. Average value per ton increased from $3.59 in 1967 to $3.72. Belmont County was the leading area for strip-mined tonnage accounting for 6.6 million tons followed by Harrison and Jefferson Counties with 4.7 million and 4.0 million tons, respectively. Coshocton, Muskingum, Noble, and Tuscarawas Counties, each with production exceeding 1.9 million tons, also were leading producing areas. Strip mine operators used 45 electric, 24 diesel-electric, 407 diesel, and 17 gasoline powered shovels or draglines. Most of the power equipment had dipper capacities of less than 3 cubic yards; 18 shovels and 19 draglines had capacities exceeding 12 cubic yards.

Table 10.—Coal (bituminous) production

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	37,310	$137,776
1965	39,390	146,028
1966	43,341	164,444
1967	46,014	176,921
1968	48,323	191,427

Over 16.9 million tons of coal was cleaned at 20 preparation plants. Of the total, only 758,000 tons was cleaned by pneumatic methods, and the remainder was cleaned by washing. Over 12.2 million tons of the cleaned coal was from underground mines, 4.7 million tons from strip, and the remainder from auger mines. Over 3.2 million tons of coal was dried after cleaning at seven preparation plants. Nearly 25.3 million tons of coal was crushed and 3.3 million tons treated at mines having crushing or treatment facilities. Most of the coal was treated with oil for allaying dust and with calcium chloride to prevent freezing. Of the total coal output 32.3 million tons were shipped by rail or water, 13.1 million tons by truck and the rest was consumed locally. Production at captive mines totaled 6.2 million tons compared with 6.3 million tons in 1967.

Preliminary employment data indicates that an average of 7,700 men worked 15 million man-hours, compared with 14.8 million man-hours in 1967. Thirteen fatalities and 435 nonfatal injuries were recorded, nine more fatalities than in 1967. Most of the fatalities were at underground mines. In National Safety Competition, Surface-Coal Group, Certificates of Achieve-

Table 11.—Coal (bituminous) production, by counties[1]

(Thousand short tons and thousand dollars)

County	1967					1968				
	Number of mines			Total production		Number of mines			Total production	
	Underground	Strip	Auger	Quantity	Value	Underground	Strip	Auger	Quantity	Value
Athens	7	1	------	260	$992	6	2	------	227	$880
Belmont	10	18	7	10,647	43,257	9	22	5	12,566	50,595
Carroll	1	10	1	434	1,488	------	7	1	454	1,707
Columbiana	5	30	16	1,264	4,219	3	28	12	1,133	3,780
Coshocton	4	11	4	2,860	12,078	3	11	2	2,742	11,654
Gallia	6	3	2	173	474	2	5	3	107	314
Guernsey	------	10	1	1,986	5,231	1	6	1	509	1,582
Harrison	7	19	4	10,826	44,860	6	15	1	10,532	44,722
Hocking	------	7	------	56	189	------	9	------	131	506
Holmes	------	5	1	177	536	------	5	------	217	731
Jackson	4	20	2	990	3,416	3	18	------	910	3,167
Jefferson	4	33	11	4,718	17,608	5	32	12	5,022	18,999
Lawrence	------	2	------	W	W	------	4	------	W	W
Mahoning	------	12	------	563	2,151	------	12	------	505	2,054
Meigs	2	1	------	68	203	1	2	1	49	153
Monroe	1	------	------	W	W	1	------	------	W	W
Morgan	------	3	------	1,011	3,569	------	1	------	W	W
Muskingum	3	12	1	620	1,830	3	13	1	2,013	8,212
Noble	------	11	3	2,076	6,868	------	11	4	2,382	8,077
Perry	5	11	1	2,170	8,489	6	12	1	3,108	11,643
Stark	------	13	1	445	1,445	------	11	------	335	1,143
Tuscarawas	6	29	6	2,855	10,124	4	27	10	2,532	9,671
Vinton	2	8	------	219	925	2	8	------	227	953
Washington	------	2	------	177	W	------	1	------	W	W
Wayne	------	2	------	17	W	------	1	------	27	W
Undistributed	XX	XX	XX	1,400	6,974	XX	XX	XX	2,597	10,885
Total[2]	67	273	61	46,014	176,921	55	263	54	48,323	191,427

XX Not applicable.
W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Excludes mines producing less than 1,000 short tons.
[2] Data may not add to totals shown because of independent rounding.

ment in Safety were awarded to Georgetown No. 12 and Bradford No. 16 mines of Hanna Coal Co., Division of Consolidation Coal Co., Broken Aro mine of Peabody Coal Company, Carol 3 strip mine of Nucci Coal Co., Keller No. 3 strip mine of Keller Mines, Inc., and Springfield strip mine of Thompson Bros. Mining Co. In the Underground Coal Group, the Low Ash No. 2 mine of Monroe Coal Co. was awarded a safety certificate. All mines worked without any disabling injuries during the year.

Coke and Coal Chemicals.—Oven-coke production increased 4 percent above that of 1967. Output was 8.4 million tons valued at $145.3 million. Average value per ton of coke also was higher. Twelve million tons of coal was carbonized at coke plants; coke yield averaged 70.23 percent.

Peat.—Shipments and value of peat were below that of 1967 but higher unit prices were reported. The average value per ton increased from $13.68 in 1967 to $14.42. Production was reported in ten counties; Stark County ranked first in tonnage with two operations. At active operations, production of moss peat predominated but quantities of reed-sedge and humus peat also were recovered. Ohio peat was processed prior to marketing mostly by shredding and drying. Only a limited quantity was unprepared. Peat was sold chiefly in bulk form for soil improvement purposes.

Petroleum and Natural Gas.—Production of both petroleum and natural gas was greater than that of 1967. However, total well completions declined, according to the American Association of Petroleum Geologists. Well completions totaled 1,163 compared with 1,261 in 1967 but total footage drilled increased from 4,088,000 to 4,207,000. A total of 1,084 development and 79 wildcat completions were reported. Development completions were drilled in 41 counties; Stark County with 307 wells was the leading area. Development activity also was significant in Licking and Carroll Counties. Wildcat completions were reported in 27 counties compared with 34 in 1967. Monroe and Washington Counties with 13 and 12 wells, respectively, were the leading areas for wildcat activity. Drilling operations in Ohio were mainly by the cable tool method.

According to the American Gas Association and American Petroleum Institute, reserves on December 31, 1968, were 783,875 million cubic feet of natural gas (14.73 pounds per square inch absolute, at 60° F), 132.3 million barrels of crude petroleum, and 523,000 barrels of natural gas liquids. Reserves of natural gas increased by 21.1 million cubic feet and petroleum by 18.1 million barrels. Natural gas liquid reserves declined by 59,000 barrels. Of the natural gas reserves, 432,653 million cubic feet was held in underground storage. Fort Worth Refining Co. (formerly Permian Corp.) operated a natural gas processing plant at Edison, Morrow County. Propane, butane, and LP-gas mix were recovered by the refrigeration-absorption process.

Refineries were active throughout the State processing crude petroleum into gaso-

Table 12.—Oil and gas well drilling in 1968, by counties

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Ashland	16	1	13	------	------	------	30	25,604
Ashtabula	------	------	2	------	1	1	4	17,005
Athens	12	6	2	1	------	------	21	38,336
Belmont	1	------	2	------	------	------	3	3,581
Butler	------	------	1	------	------	------	1	3,285
Carroll	60	4	1	7	------	1	73	389,873
Champaign	------	------	------	------	------	2	2	3,973
Columbiana	------	7	------	------	1	2	10	58,024
Coshocton	47	3	9	------	1	------	60	190,284
Crawford	------	------	------	------	------	3	3	10,187
Darke	1	------	------	------	------	------	1	1,235
Delaware	3	------	2	------	------	------	5	13,980
Erie	------	------	------	------	1	1	2	7,831
Fairfield	------	------	------	------	------	2	2	8,674
Fulton	------	------	1	1	------	------	2	6,268
Guernsey	9	18	6	1	1	------	35	133,928
Harrison	------	------	------	------	------	1	1	6,149
Henry	------	------	2	------	------	------	2	3,290
Hocking	7	3	1	------	------	1	12	36,974
Holmes	2	------	1	------	------	1	4	14,280
Huron	1	------	1	------	------	3	5	18,330
Jackson	------	------	------	------	------	1	1	1,939
Jefferson	1	------	------	------	------	------	1	1,408
Knox	16	6	5	------	------	------	27	73,901
Lawrence	------	8	1	------	------	------	9	31,591
Licking	73	7	13	1	------	2	96	242,693
Lorain	5	11	3	------	------	1	20	46,029
Mahoning	1	5	------	------	------	------	6	32,211
Marion	1	------	2	------	------	------	3	6,744
Medina	8	15	10	------	------	------	33	103,547
Meigs	3	------	4	------	------	------	7	8,051
Mercer	1	------	------	------	------	------	1	1,624
Monroe	23	9	13	6	3	4	58	162,441
Morgan	1	4	6	------	------	------	11	8,296
Morrow	19	4	19	------	------	2	44	136,193
Muskingum	36	18	9	1	------	------	64	195,995
Noble	------	1	2	1	1	------	5	9,261
Ottawa	1	------	3	------	------	------	4	7,444
Perry	24	3	6	------	------	------	33	95,753
Pike	------	1	------	------	------	1	2	5,541
Portage	------	4	1	------	------	------	5	22,015
Richland	------	------	------	1	------	2	3	12,216
Sandusky	1	------	------	------	------	------	1	1,272
Scioto	------	1	------	------	------	------	1	315
Stark	276	21	10	2	------	1	310	1,543,860
Tuscarawas	19	34	5	------	1	2	61	278,435
Vinton	2	------	2	------	------	------	4	6,310
Washington	17	20	10	6	4	2	59	126,839
Wayne	11	2	2	------	------	1	16	54,350
Total	698	216	170	28	14	37	1,163	4,207,365

Source: American Association of Petroleum Geologists (AAPG).

line and other products including asphalt, coke, lubricants, and paraffin. Companies used catalytic and thermal cracking and reforming, hydrocracking, coking, and alkylation processes for recovering the gasoline and other products.

METALS

Aluminum.—Output and value of primary aluminum produced at the Hannibal reduction plant of Ormet Corp. were greater than that of 1967. A higher average value per ton was also reported. Ormet Corp., jointly owned by Olin-Mathieson Chemical Corp. and Revere Copper & Brass, Inc., reduced alumina obtained by barge from a company-owned plant at Burnside, La. Bauxite imported from Surinam was processed into alumina at the Burnside plant. Olin-Mathieson operated a casting and rolling mill adjacent to the reduction plant.

Beryllium.—Brush Beryllium Corp., Elmore, produced beryl metal, alloys, and compounds from hand-sorted beryl. Most of the production was beryl and beryl-copper master alloy.

Ferroalloys.—Ohio continued as the leading producer among the 16 ferroalloy-producing States. Shipments of ferroalloys were below that of 1967. Production at plants consisted chiefly of ferroalloys of boron, columbium, chromium, manganese, silicon, silvery pig iron, silicomanganese, titanium, and vanadium.

Iron and Steel.—Steel production at Ohio plants was 22.6 million short tons, 11 percent greater than that of 1967, according to the American Iron and Steel Institute. Of the total, 10.8 million tons was produced in open-hearth and Bessemer furnaces, 8.7 million tons by the basic oxygen process and the remainder in electric furnaces. Compared with 1967 levels, basic oxygen and electric furnace steel production increased 17 percent and 40 percent, respectively. Open-hearth output was only 1 percent greater than that of 1967. Production of pig iron was 15.8 million tons, 1.4 million tons above that of 1967. Shipments increased 10 percent and totaled 15.7 million tons valued at $928.2 million. Over 14.7 million tons of basic pig iron was produced, 2.6 million tons above that of 1967. At the 17 plants, 36 of the 45 blast furnaces were active. The Hubbard blast furnace of Valley Mould & Iron Co., Division of Vare Corp., which was idle in 1967, was dismantled in October.

Nearly 5.1 million tons of domestic and 3.7 million tons of imported iron ore were received at Ohio steel plants. Iron-ore receipts were 1.9 million tons greater than that of 1967. Receipts of agglomerated material having higher iron content increased by 1.3 million tons and totaled 14.4 million tons. Of the agglomerated material, 13.3 million tons was domestic regular iron ore pellets. Foreign iron ore imported by Ohio steel companies came chiefly from Labrador and other parts of Canada and from Venezuela. Lesser quantities were shipped from Africa, Chile, and Brazil. Blast furnaces consumed 4.2 million tons of domestic and 1.4 million tons of foreign iron ore as well as 17.9 million tons of agglomerates. In addition, 2.1 million tons of limestone and 1.1 million tons of dolomite were consumed as fluxing material. Tonnages of other materials consumed were coke and coke breeze 10.4 million, home and purchased scrap 882,000, slag scrap 274,000, mill cinder and roll scale 629,000, open-hearth, basic oxygen, and Bessemer slag 804,000, and flue dust 95,000. Over 5.3 million tons of slag and 173,000 tons of scrap iron were produced at blast furnaces and 621,000 tons of flue dust was recovered. Steel producers also consumed substantial quantities of supplemental fuels in blast furnaces including natural and coke-oven gas, bunker oil, and tar as well as oxygen.

Titanium.—Titanium sponge metal was produced by sodium reduction of titanium tetrachloride at the Ashtabula plant of Reactive Metals, Inc., jointly owned by United States Steel Corp. and National Distillers & Chemical Corp. The sponge was shipped to the company's Niles plant for melting and processing. Titanium was also melted at the Massillon and Canton plants of Republic Steel Corp. Titanium Metals Corporation of America (TMCA) rolled and fabricated at Toronto primary metal shipped from Henderson, Nevada. Titanium pigments (titanium dioxide) used in manufacturing paint was produced at the Ashtabula plant of Cabot Titanium Corp.

Zirconium.—Reactive Metals, Inc. produced zirconium chunklets at Ashtabula. The chunklets were shipped to Niles for ingot production. Zircon- and zirconia-based refractories were produced by the Chas. Taylor Sons Co., Cincinnati. Zirconium Corporation of America (ZIRCOA), Solon, produced zirconium oxide as well as zircon refractories.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives: Metallic:			
Cleveland Metal Abrasive Co., Div. of Fanner Mfg. Co.	Brookside Park Cleveland, Ohio 44109	Plant	Cuyahoga.
Do		do	Lucas.
Globe Steel Abrasives Co	P.O. Box 1247, P.O. Annex Mansfield, Ohio 44903	do	Richland.
Metal Blast, Inc	871 East 67th St. Cleveland, Ohio 44100	do	Cuyahoga.
The National Metal Abrasive Co.	3560 Norton Rd. Cleveland, Ohio 44111	do	Do.
Steel Abrasives, Inc	Hamilton, Ohio 45010	do	Butler.
Cement:			
Alpha Portland Cement Co.[1]	15 South 3d St. Easton, Pa. 18043	do	Lawrence.
Columbia Cement Co.[2]	P.O. Box 1513 Zanesville, Ohio 43701	do	Muskingum.
The Diamond Portland Cement Co.,[3] Div. of The Flintkote Co.	Middle Branch, Ohio 44652	do	Stark.
General Portland Cement Co.,[4] Peninsular Portland Cement Div.	709 Clay St. Ft. Wayne, Ind. 46802	do	Paulding.
Marquette Cement Mfg. Co.[5]	20 N. Wacker Dr. Chicago, Ill. 60606	do	Lawrence.
Medusa Portland Cement Co.[6]	P.O. Box 5668 Cleveland, Ohio 44101	do	Lucas.
PPG Industries, Inc.[7]	P.O. Box 31 Barberton, Ohio 44203	do	Summit.
Southwestern Portland Cement Co.[4]	P.O. Box 191 Fairborn, Ohio 45324	do	Greene.
Universal Atlas Cement Div.,[4] United States Steel Corp.	Chatham Center, Box 2969 Pittsburgh, Pa. 15230	do	Do.
Clays:			
Fire clay:			
AFC Corporation	P.O. Box 157 Canfield, Ohio 44406	Pit	Mahoning.
The Belden Brick Co	P.O. Box 910 Canton, Ohio 44701	Pit	Holmes.
The Belden Brick Co.[8] [9]		Pit	Stark.
The Belden Brick Co.[8] [10]		Pit	Tuscarawas.
The Belden Brick Co		Underground	Do.
Cedar Heights Clay Co.[10]	P.O. Box 368 Oak Hill, Ohio 45656	Pit	Jackson.
Evans Brick & Pipe Co., Inc.[8]	Uhrichsville, Ohio 44683	Pit	Tuscarawas.
Glen Gery Corporation	P.O. Box 1656 East Canton, Ohio 44730	Pit	Athens.
Do		Pit	Mahoning.
Glen Gery Corporation [9]		Pit	Carroll.
Do		Pit	Stark.
Kimble Coal Co.[8]	R.D. 1 Dover, Ohio 44622	Pit	Tuscarawas.
Metropolitan Industries, Inc.	306 Market Ave. North Canton, Ohio 44702	Pit	Columbiana.
H. K. Porter Co., Inc	Porter Bldg. Pittsburgh, Pa. 15219	Underground	Do.
Do		do	Jefferson.
Miscellaneous clay and shale:			
American Vitrified Products Co	701 National City Bank Bldg. Cleveland, Ohio 44114	Pit	Columbiana.
Do		Pit	Tuscarawas.
The Claycraft Co	P.O. Box 866 Columbus, Ohio 43216	Pit	Franklin.
Do		Pit	Tuscarawas.
Do		Pit	Wyandot.
Cleveland Builders Supply Co.[9]	2100 West 3d St. Cleveland, Ohio 44113	Pit	Cuyahoga.
The Galena Shale Tile & Brick Co.	Galena, Ohio 43021	Pit	Delaware.
Hydraulic Press Brick Co	705 Olive St. St. Louis, Mo. 63101	Pit	Cuyahoga.
Marion Brick Corp	Box 548 Marion, Ohio 43301	Pit	Marion.
The Richland Shale Brick Co.	Box 328 Mansfield, Ohio 44901	Pit	Richland.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal (bituminous):			
B & N Coal Company [11]	Box 100 Dexter City, Ohio 45727	Strip	Noble.
Do.[9]		Auger	Do.
Boich Mining Company	R.D. 1 Bloomingdale, Ohio 43910	Strip	Jefferson.
Central Ohio Coal Company [12]	Box 98 Cumberland, Ohio 43732	do	Morgan, Muskingum, and Noble.
Do.[13]		do	Muskingum and Noble.
Cravat Coal Company	R.D. 1 Hopedale, Ohio 43826	do	Belmont.
Cross Creek Coal Co	Box 167 New Philadelphia, Ohio 44663	do	Tuscarawas.
Hanna Coal Company, Division of Consolidation Coal Co.	Cadiz, Ohio 43907	do	Belmont.
Do		do	Jefferson.
Do.[13]		do	Belmont and Harrison.
Do.[10]		do	Harrison.
Do.[9]		Underground	Do.
Huberta Coal Company, Inc	P.O. Box 728 Steubenville, Ohio 43952	Strip	Jefferson.
J & M Mining, Inc.[9]	P.O. Box 188 New Philadelphia, Ohio 44663	do	Tuscarawas.
The James Brothers Coal Co	S. Main St. Magnolia, Ohio 44643	do	Carroll.
Do		do	Tuscarawas.
Midvale Coal Company, Inc	P.O. Box 259 Midvale, Ohio 44653	Underground	Do.
Noon Coal Company [9]	P.O. Box 100 Dexter City, Ohio 45727	Strip	Noble.
Noon Coal Company		Auger	Do.
The North American Coal Corporation.[9]	12800 Shaker Boulevard Cleveland, Ohio 44120	Underground	Belmont.
The North American Coal Corporation.		do	Jefferson.
Do.[13]		do	Monroe and Belmont.
Oglebay Norton Company [9]	P.O. Box 6508 Cleveland, Ohio 44101	do	Belmont.
Ohio River Collieries Company	Route 1 Bloomingdale, Ohio 43910	Strip	Do.
Do		Auger	Do.
Peabody Coal Company	301 No. Memorial Drive St. Louis, Mo. 63102	Strip	Coshocton.
Do.[9]		do	Perry.
Do.[10]		Underground	Do.
R. & F. Coal Company [11]	Box 218 Cadiz, Ohio 43807	Strip	Belmont.
R. & F. Coal Company		do	Harrison.
Simco Peabody Coal Company	301 N. Memorial Drive St. Louis, Mo. 63102	Strip	Coshocton.
Do		Underground	Do.
Teramana Brothers Coal Company.[9]	P.O. Box 850 Steubenville, Ohio 43952	Strip	Jefferson.
Termel Coal Corporation	R.D. 2 St. Clairsville, Ohio 43950	do	Harrison.
The Youghiogheny & Ohio Coal Company [9]	4614 Prospect Ave. Cleveland, Ohio 44100	Underground	Do.
Ferroalloys:			
Foote Mineral Co	Dept. 602, Route 100 Exton, Pa. 19341	Plant	Guernsey.
Do		do	Jefferson.
Interlake Steel Corp	210 S. Michigan Ave. Chicago, Ill. 60604	do	Washington.
Jackson Iron & Steel Co	Jackson, Ohio 45640	do	Jackson.
Ohio Ferro-Alloys Corp	837 30th NW., Canton, Ohio 44714	do	Jefferson.
Do		do	Muskingum.
Do		do	Belmont.
Union Carbide Corp	270 Park Ave. New York, N.Y. 10017	do	Ashtabula.
Do		do	Washington.
Graphite (synthetic): The Ohio Carbon Co.	12508 Berea St. Cleveland, Ohio 44100	do	Cuyahoga.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Gypsum:			
Crude:			
The Celotex Corporation [14]	1500 N. Dale Mabry Tampa, Fla. 33607	Pit	Ottawa.
United States Gypsum Company.[14]	101 S. Wacker Dr. Chicago, Ill. 60606	Underground	Do.
Calcined: National Gypsum Company.	325 Delaware Ave. Buffalo, N.Y. 14202	Plant	Lorain.
Lime:			
The J. E. Baker Co	P.O. Box 1189 York, Pa. 17405	do	Sandusky.
Basic, Incorporated	845 Hanna Bldg. Cleveland, Ohio 44115	do	Seneca.
Cuyahoga Lime Company	Menlo Park, N.J. 08817	do	Cuyahoga.
Diamond Shamrock Corp	300 Union Commerce Bldg. Cleveland, Ohio 44115	do	Lake.
Grand River Lime Company	Delaware, Ohio 43015	do	Do.
The National Lime & Stone Co	First Nat'l. Bank Bldg. Findlay, Ohio 45840	do	Wyandot.
Huron Lime Co	P.O. Box 428 Huron, Ohio 44839	do	Erie.
Ohio Lime Co	Woodville, Ohio 43469	do	Sandusky.
Chas. Pfizer & Co., Inc	836 National Bank Bldg. Toledo, Ohio 43604	do	Do.
PPG Industries, Inc	Barberton, Ohio 44203	do	Summit.
Standard Lime & Refractories Co	2000 First Nat'l. Bank Bldg. Baltimore, Md. 21203	do	Sandusky.
Union Carbide Corp., Chemicals & Plastics.	P.O. Box 299 Marietta, Ohio 45750	do	Ashtabula.
United States Gypsum Co	101 S. Wacker Dr. Chicago, Ill. 60606	do	Ottawa.
Lime (regenerated):			
City of Dayton, Dept. of Water	1044 Ottawa Street Dayton, Ohio 45400	do	Montgomery.
The Mead Corp., Chillicothe Div	Chillicothe, Ohio 45601	do	Ross.
Peat:			
Beaver Peat Products Co	Box 136 Damascus, Ohio 44619	Bog	Mahoning.
Corell Peat Moss	Box 340, Rt. 1 Beach City, Ohio 44608	Bog	Stark.
Green Oaks Peat Moss Co	R.D. 4 Ravenna, Ohio 44266	Bog	Portage.
The Humus Co	2628 S. Michigan St. South Bend, Ind. 46600	Bog	Wyandot.
Lantz Peat Moss, Inc	4594 Fulton Dr., N.W. Canton, Ohio 44718	Bog	Stark.
Louis Meyer	Route 5 Greenville, Ohio 45303	Bog	Darke.
Montgomery Peat Moss Co	Route 1 Plymouth, Ohio 44865	Bog	Huron.
Dan E. Poljack	19675 Sheldon Rd. Berea, Ohio 44017	Bog	Cuyahoga.
Reynolds Farms, Inc	Route 1 Shelby, Ohio 44875	Bog	Richland.
Raymond Sheets	3832 12th St. Canton, Ohio 44708	Bog	Stark.
Sphagum Peat Moss Products	Rt. 1 West Liberty, Ohio 43357	Bog	Champaign.
Paul Thompson Peat Co	R.D. 1 West Liberty, Ohio 43357	Bog	Logan.
W. C. Utzinger & Sons	State Route 104 Grove City, Ohio 43123	Bog	Franklin.
Perlite (expanded):			
The Cleveland Gypsum Co., Div. Cleveland Builders Supply Co.[15]	2100 West 3d St. Cleveland, Ohio 44113	Plant	Cuyahoga.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	do	Lorain.
Philip Carey Corporation	320 S. Wayne Ave. Cincinnati, Ohio 45215	do	Hamilton.
United States Gypsum Co	101 S. Wacker Dr. Chicago, Ill. 60606	Plant	Ottawa.
Petroleum refineries:			
Ashland Oil & Refining Co	1409 Winchester Ave. Ashland, Ky. 41101	do	Hancock.
Do		do	Stark.
Chevron Asphalt Company	555 Market St. San Francisco, Calif. 94105	do	Hamilton.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Petroleum refineries—Continued			
Gulf Oil Corp	Pittsburgh, Pa. 15219	Plant	Hamilton.
Do		do	Lucas.
The Pure Oil Company, Div. of Union Oil Company of California.	Union Center Los Angeles, Calif. 90017	do	Licking.
Do		do	Lucas.
The Standard Oil Company of Ohio.	Midland Bldg. Cleveland, Ohio 44115	do	Allen.
Do		do	Lucas.
Sun Oil Company [16]	1608 Walnut St. Philadelphia, Pa.	do	Do.
Salt:			
Brine:			
Diamond Shamrock Corp	300 Union Commerce Bldg. Cleveland, Ohio 44115	Well	Lake.
PPG Industries, Inc.[17]	P.O. Box 31 Barberton, Ohio 44203	do	Summit.
Evaporated:			
Diamond Crystal Salt Co.[18]	916 So. Riverside St. Clair, Mich. 48079	do	Summit.
Excelsior Salt Works, Inc	P.O. Box 267 Pomeroy, Ohio 45769	do	Meigs.
Morton Salt Co., Div. of Morton International, Inc.	110 No. Wacker Dr. Chicago, Ill. 60606	do	Wayne.
Rock:			
International Salt Co.[17]	Clarks Summit, Pa. 18411	Underground	Cuyahoga.
Morton Salt Co., Div. of Morton International, Inc.	110 No. Wacker Dr. Chicago, Ill. 60606	do	Lake.
Sand and gravel:			
American Aggregates Corp	Garst Avenue at Avenue B Greenville, Ohio 45331	Pit	Champaign.
Do		Pit	Clark.
Do		Dredge	Do.
Do		Pit	Darke.
Do		Pit	Licking.
Do.[11]		Pit	Franklin.
Do.[9]		Pit	Montgomery.
American Materials Corp.[9]	P.O. Box 154 Hamilton, Ohio 45010	Pit	Butler.
American Materials Corp		Pit	Hamilton.
Canton Aggregate Co.[11]	1243 Raff Rd. SW. P.O. Box 1387 Sta. C Canton, Ohio 44708	Pit	Stark.
The Central Silica Co	806 Market St. Zanesville. Ohio 43701	Pit	Perry.
Hilltop Concrete Corp	Lane Avenue Cincinnati, Ohio 45214	Pit	Greene.
Wm. Miller Sand & Gravel Co	1287 Jackson Pike Columbus, Ohio 43200	Pit	Franklin.
The Millwood Sand Company	806 Market St. Zanesville, Ohio 43701	Pit	Knox.
Moraine Materials Co.[11]	2500 East River Road Dayton, Ohio 45409	Pit	Montgomery.
Morrow Gravel Company	3535 Round Bottom Road Cincinnati, Ohio 45244	Pit	Knox.
Do		Pit	Warren.
Ohio Gravel Co., Div. of Dravo Corp.[9]	5253 Wooster Road Cincinnati, Ohio 45226	Pit	Butler.
Do		Pit	Warren.
Do.[10]		Pit	Hamilton.
Pennsylvania Glass Sand Corp.[9]	General Operations Dept. Berkeley Springs, W.Va. 25411	Pit	Portage.
Pennsylvania Glass Sand Corp		Pit	Tuscarawas.
R. W. Sidley, Inc	R.F.D. 1 Thompson, Ohio 44086	Pit	Geauga.
Do	Plainsville, Ohio 44077	Pit	Lake.
Edgar Spring, Inc.[9]	Box 507 New Philadelphia, Ohio 44663	Pit	Columbiana.
Edgar Spring, Inc		Pit	Holmes.
Do.[19]		Pit	Tuscarawas.
The Standard Slag Co	1200 Stambaugh Bldg. Youngstown, Ohio 44501	Pit	Pike.
Do		Pit	Portage.
Do		Pit	Scioto.
Tri-State Materials Corp	Box 1933 Parkersburg, W.Va. 26100	Pit	Meigs.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Smelters:			
Aluminum: Ormet Corp		Plant	Monroe.
Titanium sponge: Reactive Metals, Inc.		do	Ashtabula.
Zinc: American Zinc Oxide Company.		do	Franklin.
Stone:			
Dolomite (crushed):			
The J. E. Baker Company	Box 1189 York, Pa. 17405	Quarry	Sandusky.
The Melvin Stone Co	R.R. 4 Wilmington, Ohio 45177	do	Clinton.
Dolomite (dimension): E. R. Lintner Co.	Route 2 Bellevue, Ohio 44811	do	Seneca.
Limestone (crushed):			
American Aggregates Corp	Garst Ave. at Ave. B Greenville, Ohio 45331	do	Madison.
Do.[9]		do	Montgomery.
Armco Steel Corp	P.O. Box 911 Piqua, Ohio 45356	do	Miami.
Basic Inc	845 Hanna Bldg. Cleveland, Ohio 44115	do	Seneca.
Bessemer Cement Co., Subsidiary of Lousiville Cement Co.[8]	510 Hanna Bldg. Cleveland, Ohio 44115	do	Mahoning.
Carbon Limestone Co	Lowellville, Ohio 44436	do	Do.
Davon, Inc.[9]	Box 5765 Columbus, Ohio 43221	do	Adams.
Davon, Inc		do	Highland.
The France Stone Co	1800 Toledo Trust Bldg. Toledo, Ohio 43604	do	Lucas.
Do		do	Paulding.
Do		do	Sandusky.
Do.[9]		do	Wood.
Marble Cliff Quarries Co	2100 Tremont Center Columbus, Ohio 43221	do	Delaware.
Do		do	Franklin.
Do		do	Preble.
Maumee Stone Co	P.O. Box 369 Maumee, Ohio 43537	do	Lucas.
Do		do	Paulding.
Do.[9]		do	Wood.
National Lime & Stone Co	First National Bank Bldg. Findlay, Ohio 45840	do	Allen, Auglaize, Crawford, Delaware, Hancock, Marion, Putnam, Wyandot.
Ohio Lime Co	Woodville, Ohio 43469	do	Sandusky.
Chas. Pfizer & Co., Inc	836 National Bank Bldg. Toledo, Ohio 43604	do	Do.
Sandusky Crushed Stone Co., Inc.	P.O. Box 527 Sandusky, Ohio 44870	do	Erie.
Standard Lime & Refractories Co., Div. Martin Marietta Corp.	2000 First National Bank Bldg. Baltimore, Md. 21203	do	Sandusky.
Standard Slag Co	1200 Stambaugh Bldg. Youngstown, Ohio 44501	do	Mahoning and Ottawa.
Toledo Stone & Glass Sand Co.	1800 Toledo Trust Bldg. Toledo, Ohio 43604	do	Lucas.
Wagner Quarries Co	East Market St. Sandusky, Ohio 44870	do	Erie.
Woodville Lime & Chemical Co.	Box 218 Woodville, Ohio 43469	do	Sandusky.
Limestone (dimension): Gregory Stone Co., Inc.	R.D. 1 Ludlow Falls, Ohio 45339	do	Miami.
Quartzite (crushed):			
Cambria Clay Products Co	Black Fork, Ohio 45615	do	Pike.
A. P. Green Refractories Co., Durex Division.	P.O. Box 255 Oak Hill, Ohio 45656	do	Do.
Harbison-Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15222	do	Geauga.
Southern Silica, Inc.[9]	Box 22 Richmondale, Ohio 45673	do	Ross.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Sandstone (crushed):			
Alan Stone Company, Inc.	P.O. Box 127 Chesterhill, Ohio 43728	Quarry	Meigs.
Walter C. Best, Inc.	Box 87 Chardon, Ohio 44024	do	Geauga.
PPG Industries, Inc.	P.O. Box 31 Barberton, Ohio 44203	do	Summit.
Sperry Road Sand & Gravel Co., Inc.	R.D. 4, Hobart Willoughby, Ohio 44094	do	Lake.
Sandstone (dimension):			
Briar Hill Stone Co.[19]	Glenmont, Ohio 44628	do	Coshocton.
Do.[9]		do	Holmes.
Briar Hill Stone Co.		do	Knox.
Cleveland Quarries Co.	Amherst, Ohio 44001	do	Erie.
Do.[20], [21]		do	Lorain.
Stutzman Stone Co.	R.D. 1 Dover, Ohio 44622	do	Tuscarawas.
The Taylor Stone Co.	McDermott, Ohio 45652	do	Scioto.
The Waller Brothers Stone Co.		do	Do.

[1] Also cement rock. [2] Also shale and limestone. [3] Also clay, shale, and limestone. [4] Also clay and limestone. [5] Also cement rock, limestone, and shale. [6] Also sand, shale, and limestone. [7] Also limestone. [8] Also shale. [9] 2 operations. [10] 4 operations. [11] 3 operations. [12] 1 operation in 3 counties. [13] 1 operation in 2 counties. [14] Also calcined. [15] Also exfoliated vermiculite. [16] Also byproduct sulfur. [17] Also evaporated salt. [18] Also brine. [19] 5 operations. [20] Also grindstones and crushed sandstone. [21] 6 operations.

The Mineral Industry of Oklahoma

This chapter has been prepared under a cooperative agreement between the Bureau of of Mines, U.S. Department of the Interior, and the Oklahoma Geological Survey for collecting information on all minerals except fuels.

By Arel B. McMahan[1] and William E. Ham[2]

Value of mineral output in Oklahoma in 1968 exceeded $1 billion for the second consecutive year. Losses in value were reported in output of natural gas, natural gas liquids, crude petroleum, helium, lime, salt, volcanic ash, lead, and zinc. Gains were recorded in output value of cement, clays, copper, gypsum, sand and gravel, silver, stone, and tripoli. A significant gain in coal output resulted from accelerated mining activities in Haskell, Le Flore, and Rogers Counties.

Mineral fuels and related products contributed more than 94 percent to the State's total mineral output value. Petroleum and natural gas occurrences are widely distributed throughout Oklahoma with petroleum production being reported from 65 counties and natural gas from 64. Helium was extracted from natural gas in Cimarron County. Coal was produced in seven counties (two counties produced less than 1,000 tons) in the eastern part of the State.

Nonmetals were produced principally in the central and eastern portions of the State. Copper and silver ores were mined in Jackson County, zinc and lead ores in Ottawa County.

Employment and Wages.—The Oklahoma Employment Security Commission reported 40,800 persons employed in the mineral industry; more than 95 percent

Table 1.—Mineral production in Oklahoma[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] ---------- thousand short tons --	744	$869	726	$967
Coal (bituminous) ---------- do ----	823	4,703	1,089	6,401
Gypsum ---------- do ----	804	2,266	931	2,565
Helium, grade A ---------- thousand cubic feet --	309,100	9,835	308,600	8,700
Lead (recoverable content of ores, etc.) ---------- short tons --	2,727	764	2,387	631
Natural gas ---------- million cubic feet --	1,412,952	202,052	1,390,884	197,506
Natural gas liquids:				
Natural gasoline and cycle products thousand 42-gallon barrels --	13,545	35,846	13,905	38,829
LP gases ---------- do --	28,944	49,276	25,497	39,520
Petroleum (crude) ---------- do ----	230,749	676,095	223,623	668,202
Salt ---------- thousand short tons --	10	76	7	44
Sand and gravel ---------- do ----	4,540	5,280	5,041	6,288
Stone ---------- do ----	16,355	18,932	17,290	21,950
Zinc (recoverable content of ores, etc.) ---------- short tons --	10,670	2,954	6,921	1,869
Value of items that cannot be disclosed: Bentonite, cement, copper, lime, silver, tripoli, and volcanic ash ----------	XX	23,178	XX	23,360
Total ----------	XX	1,032,126	XX	1,016,832
Total 1957–59 constant dollars ----------	XX	996,673	XX	p 986,056

p Preliminary. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes bentonite; included with "Value of items that cannot be disclosed."

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[1] Mineral specialist, Bureau of Mines, Bartlesville, Okla.

[2] Geologist, Oklahoma Geological Survey, Norman, Okla.

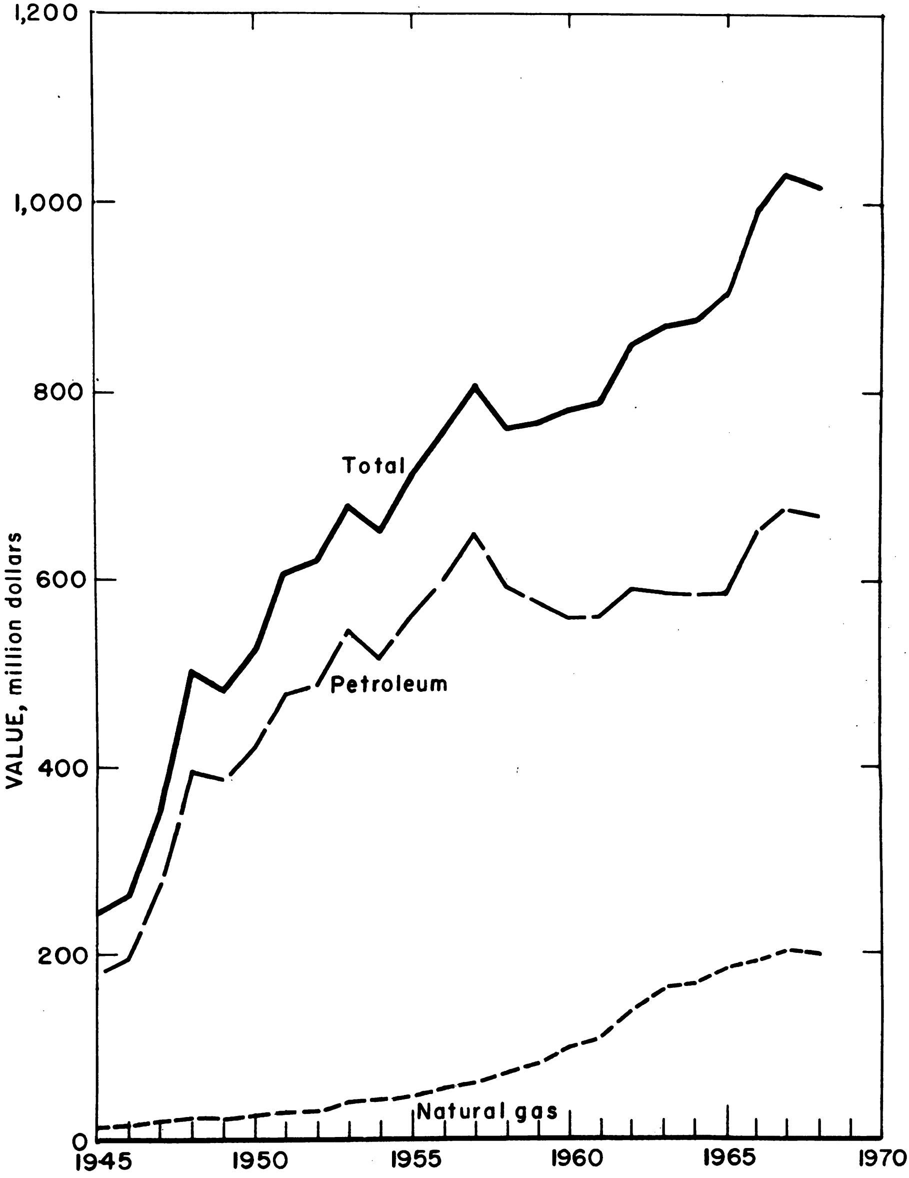

Figure 1.—Value of natural gas, petroleum, and total value of mineral production in Oklahoma.

Table 2.—Value of mineral production in Oklahoma by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Alfalfa	$9,014	$6,592	Petroleum, natural gas, natural gas liquids, sand and gravel.
Atoka	W	W	Stone, sand and gravel, petroleum.
Beaver	53,736	50,575	Natural gas, petroleum, natural gas liquids, volcanic ash.
Beckham	12,998	7,652	Natural gas, natural gas liquids, petroleum.
Blaine	9,602	11,808	Petroleum, natural gas, gypsum, natural gas liquids, sand and gravel.
Bryan	1,897	2,527	Petroleum, natural gas, sand and gravel, stone.
Caddo	23,059	21,902	Petroleum, natural gas, stone, natural gas liquids, gypsum, sand and gravel.
Canadian	1,960	2,591	Natural gas, petroleum, sand and gravel, clays, gypsum.
Carter	62,411	61,777	Petroleum, natural gas liquids, natural gas, stone.
Cherokee	W	W	Stone.
Choctaw	897	272	Stone, sand and gravel.
Cimarron	14,923	14,780	Helium, petroleum, natural gas, natural gas liquids, stone.
Cleveland	17,712	17,045	Petroleum, natural gas, natural gas liquids.
Coal	2,564	2,469	Petroleum, natural gas, stone, sand and gravel.
Comanche	3,103	3,194	Stone, gypsum, petroleum, natural gas, sand and gravel.
Cotton	4,836	4,128	Petroleum, sand and gravel, natural gas.
Craig	324	168	Coal, petroleum, natural gas.
Creek	34,046	37,161	Petroleum, natural gas liquids, stone, natural gas, clays.
Custer	4,125	4,879	Petroleum, natural gas, clays.
Dewey	24,129	27,423	Petroleum, natural gas, natural gas liquids, clays.
Ellis	13,285	10,370	Natural gas, petroleum.
Garfield	43,175	39,574	Petroleum, natural gas, natural gas liquids, sand and gravel.
Garvin	71,897	69,001	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Grady	22,968	20,642	Petroleum, natural gas, natural gas liquids.
Grant	7,208	7,352	Do.
Greer	359	440	Stone, petroleum, clays, natural gas.
Harmon	65	20	Salt.
Harper	19,718	20,466	Natural gas, natural gas liquids, petroleum, sand and gravel, stone.
Haskell	7,228	8,225	Natural gas, coal, stone.
Hughes	5,212	5,397	Petroleum, natural gas, sand and gravel.
Jackson	3,151	3,242	Copper, petroleum, gypsum, sand and gravel, silver.
Jefferson	3,107	3,133	Petroleum, natural gas.
Johnston	W	W	Sand and gravel, stone.
Kay	14,384	14,399	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Kingfisher	46,398	50,424	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kiowa	1,457	1,360	Stone, petroleum, sand and gravel, natural gas.
Latimer	10,760	14,726	Natural gas.
Le Flore	2,706	4,008	Natural gas, stone, coal, sand and gravel.
Lincoln	14,132	12,708	Petroleum, natural gas liquids, natural gas.
Logan	11,894	9,619	Petroleum, natural gas, sand and gravel, natural gas liquids.
Love	9,227	7,193	Petroleum, natural gas, natural gas liquids.
Major	27,699	24,663	Petroleum, natural gas, natural gas liquids, sand and gravel.
Marshall	5,878	6,660	Petroleum, natural gas liquids, natural gas, sand and gravel.
Mayes	W	W	Cement, stone, clays, petroleum.
McClain	24,726	25,283	Petroleum, natural gas, natural gas liquids, sand and gravel, stone.
McCurtain	792	945	Stone, sand and gravel, petroleum.
McIntosh	141	308	Natural gas, stone, petroleum.
Murray	3,716	4,391	Stone, petroleum, sand and gravel, natural gas.
Muskogee	4,912	3,168	Petroleum, stone, sand and gravel, coal, natural gas.
Noble	6,939	6,138	Petroleum, natural gas, natural gas liquids.
Nowata	2,820	2,702	Petroleum, stone, natural gas.
Okfuskee	6,399	6,212	Petroleum, natural gas, natural gas liquids.
Oklahoma	20,651	20,442	Petroleum, natural gas liquids, natural gas, sand and gravel, clays, stone.
Okmulgee	4,266	4,245	Petroleum, stone, natural gas.
Osage	54,197	50,728	Petroleum, stone, natural gas.
Ottawa	4,766	3,683	Zinc, stone, lead, tripoli.
Pawnee	5,608	5,675	Petroleum, natural gas, sand and gravel.
Payne	8,187	7,777	Petroleum, natural gas, stone, sand and gravel.
Pittsburg	1,568	3,178	Natural gas, stone, sand and gravel, clays, petroleum.
Pontotoc	20,475	19,659	Petroleum, cement, stone, sand and gravel, natural gas liquids, clays, natural gas.
Pottawatomie	12,526	10,827	Petroleum, natural gas, sand and gravel.
Pushmataha	408	11	Stone, sand and gravel.
Roger Mills	583	1,377	Petroleum, natural gas.
Rogers	12,152	14,094	Cement, coal, petroleum, stone, clays, natural gas.
Seminole	26,539	26,375	Petroleum, natural gas liquids, stone, natural gas, clays.
Sequoyah	2,944	3,168	Stone, lime, natural gas, sand and gravel.
Stephens	78,325	75,624	Petroleum, natural gas, natural gas liquids.
Texas	61,213	62,952	Natural gas, petroleum, natural gas liquids, sand and gravel.
Tillman	784	1,023	Petroleum, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Oklahoma by counties[1]—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Tulsa	$9,157	$9,920	Petroleum, stone, sand and gravel, clays, natural gas.
Wagoner	544	476	Petroleum, sand and gravel, natural gas.
Washington	6,310	5,663	Petroleum, stone, natural gas.
Washita	857	581	Natural gas, petroleum, gypsum.
Woods	7,330	9,568	Petroleum, natural gas, salt, sand and gravel.
Woodward	9,607	9,790	Natural gas, petroleum, natural gas liquids, sand and gravel.
Undistributed	9,440	10,284	
Total	1,032,126	1,016,832	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Adair and Delaware Counties are not listed because no production was reported.

Table 3.—Indicators of Oklahoma business activity

	1967	1968 p	Change (percent)
Employment and labor force, annual average:			
Total labor force thousands	978.5	998.0	+2.0
Unemployment do	34.0	35.2	+3.5
Employment:			
Construction do	32.5	34.5	+6.2
Manufacturing do	116.4	120.8	+3.8
Mining do	41.0	40.8	–.5
All industries do	944.5	962.8	+1.9
Factory payrolls do	$727.2	$817.6	+12.4
Personal income:			
Total millions	$6,594.0	$7,207.0	+9.3
Per capita	$2,621.0	$2,860.0	+9.1
Construction activity:			
Building permits, total private nonresidential millions	$80.6	$111.7	+38.6
Heavy engineering awards do	$37.4	$39.1	+4.5
State highway commission:			
Value of contracts awarded do	$85.1	$64.5	–24.2
Value of contract work performed do	$76.5	$74.0	–3.3
Cement shipments to and within Oklahoma thousand 376-pound barrels	5,258.0	6,044.7	+15.0
Farm marketing receipts millions	$806.7	$843.1	+4.5
Mineral production do	$1,032.1	$1,016.8	–1.5

p Preliminary.

Sources: Survey of Current Business, Construction Review, Oklahoma State Highway Department, Farm Income Situation, Oklahoma Employment Security Commission, U.S. Army Corps of Engineers Tulsa District, and Bureau of Mines.

were engaged in petroleum exploration and production. About 4 percent of the State's total labor force was employed by the mineral industry. Average weekly earnings of employees in the industry reached an alltime high of $130.59 in 1968.

Government Programs.—Lock and dam construction on the Arkansas-Verdigris River Navigation System in Oklahoma progressed during the year. Construction of the powerhouse at Keystone Dam was completed, and the first power run was made in April. At yearend, the U.S. Army Corps of Engineers was constructing 12 dams throughout Oklahoma.

The Chimney Hollow pump-back storage reservoir near Salina was completed by the Grand River Dam Authority. Water is raised 250 feet to the reservoir at the rate of 900,000 gallons per minute.

Subsidy payments continued to mine operators in the Tri-State District in Ottawa County under the Lead-Zinc Mining Stabilization Program (Public Law 89–238). Qualified producers were eligible for payment throughout the year on both lead and zinc; market prices for both metals remained below 14.5 cents per pound (price at which payment begins). The lead market price remained at 14.0 cents per pound through April, dropped to a low of 12.5 in July, and increased to 13.0 cents per pound through November and December. The zinc market price remained

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	252	164	41	324	1	5	18.51	19,110
Metal	399	270	108	867	1	34	40.38	14,524
Nonmetal	524	241	127	1,009	1	30	30.71	8,216
Sand and gravel	266	276	73	617	-------	17	27.55	319
Stone	1,167	263	306	2,556	-------	69	26.99	622
Total [1]	2,608	251	655	5,374	3	155	29.40	5,371
1968:[p]								
Coal	290	161	47	366	-------	6	16.39	639
Metal	350	280	98	776	-------	33	42.53	767
Nonmetal	575	238	137	1,095	-------	30	27.40	452
Sand and gravel	270	270	73	617	-------	14	22.68	1,471
Stone	1,210	267	323	2,687	1	58	21.96	2,675
Total [1]	2,700	251	678	5,541	1	141	25.63	1,700

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

at 13.5 cents per pound throughout the year.

The Bureau of Mines, Bartlesville Office of Mineral Resources, continued reconnaissance investigations (which began in 1967) of copper occurrences in western Oklahoma. The investigation, directed toward increasing the factual data and evaluating the potential of copper-bearing Permian "Red Beds" in Kansas, Oklahoma, and Texas, was scheduled for termination in June 1969. The results of the investigation will be published.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Exploration and development drilling failed to keep pace in 1968 with production causing a decline in the proved reserves of crude petroleum, natural gas, and natural gas liquids for the second time in Oklahoma oil history, according to the American Petroleum Institute (API) and American Gas Association (AGA).

A total of 2,739 wells, averaging 4,912 feet in depth, was drilled in 1968, compared with 2,852 wells, averaging 4,686 feet in depth drilled in 1967. A total of 419 exploratory wells was drilled to an average depth of 5,760 feet, compared with 437 exploration wells drilled to an average depth of 5,366 feet in 1967. Development drilling in 1968 resulted in 2,320 wells to an average depth of 4,755 feet, compared with 2,415 wells in 1967 to an average depth of 4,563 feet.

Delhi Gas Pipeline Corp., a subsidiary of Texas Oil and Gas Corp., completed installation of 110 miles of 10- and 14-inch gas pipelines in western Oklahoma; the parent company was constructing a gas-processing plant at Clinton at yearend. The 10-inch line will transport gas from Durham field in Roger Mills County and Putnam field in Dewey County to the Clinton plant. The 14-inch line will deliver residue gas from the Clinton plant to Southwestern Power plant at Washita, Okla. The gas-processing plant will recover propane and depropanized hydrocarbon mix. Initial daily processing rates will be 30,000 gallons of propane and 22,000 gallons of mix.

Arkansas-Louisiana Gas Co. and Cities Service Gas Co. completed a 135-mile, 20-inch gas pipeline from western Arkansas to southwest Missouri. The line will transport 100 million cubic feet of gas per day from Arkansas-Louisiana Gas Co.'s gasfields in eastern Oklahoma and western Arkansas to Cities Service Gas Co.'s pipeline system serving southwest Missouri.

Service Pipe Line Co. completed a second 16-inch crude oil trunk line from Drumright, Okla., to Slaughter, Tex. Completion of the line gave Service Pipe Line Co. two separate 16-inch systems between company facilities at Slaughter, Tex., a pipeline terminal at Cushing, Okla., and a trunk station at Drunright. Capacity of the dual system was 246,000 barrels per day.

Mid-Continent Pipe Line Co. completed a 10-inch pipeline from the Little Tank Farm at Cushing to Drumright. The line will increase crude oil and distillate gathering capacity in western Oklahoma.

Carbon Black.—Furnace carbon black was produced from liquid hydrocarbons by Continental Oil Co. at Ponca City, Kay County. Total output was used in manufacturing tires, shoe soles and heels, gaskets, and conveyor belts and hose. Production increased substantially in quantity and value in 1968.

Coal.—Oklahoma's bituminous coal output was produced from eight mines (six strip, one underground, and one combination auger-strip) in five counties in the eastern part of the State. Rogers County led in quantity and value of output, followed by Haskell, Craig, Le Flore, and Muskogee Counties. Coal also was produced by five operators, who mined less than 1,000 tons each, from seven mines (five strip and two underground) in Haskell, Latimer, Le Flore, and Okmulgee Counties.

Coal output for the State in 1968 increased 32 percent over that of 1967. Strip mining and one auger-strip mine accounted for most of the production, although output from underground mining increased substantially.

Table 5.—Coal (bituminous) production

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	1,028	$5,474
1965	974	5,520
1966	843	4,935
1967	823	4,703
1968	1,089	6,401

The increased coal output from underground mining was attributed to the Howe Coal Co. mine at Heavener in Le Flore County. The company began limited production in March 1968. Mine workings consist of a 9- by 20-foot inclined belt slope and a 16-foot-diameter air shaft which intersects the coal at a depth of about 200 feet. The coal is upgraded in a 80-ton-per-hour pilot washing plant using heavy media and cyclone separators. Coal from the Howe mine is hauled by rail to New Orleans, then transferred to oceangoing vessels for shipment to Japan.

Development of the Howe Coal Co. mine was expected to be completed in 1971. Construction of a second inclined shaft and a 500-ton-per-hour washing plant was scheduled to begin in 1969. The Kansas City Southern Railroad Co. was constructing 150-ton-capacity cars for the operation. The coal will be shipped to Port Arthur, Tex., in unit train lots of 65 cars when new port facilities are completed. Output of the mine was expected to be 1.25 million tons per year.

Peabody Coal Co. began development of a strip mine in Craig County. An electric-powered shovel having a bucket capacity of 40 cubic yards was erected on the company's lease in the western part of the county. A crushing, screening, and loading plant was being constructed north of Chelsea at yearend. Production from the mine began in December; full production was expected to be 500,000 tons per year. Coal will be shipped in a unit-train operation to the Kansas City metropolitan area for use in steam-electric power plants.

Kerr-McGee Corp. continued development of an underground coal mine 7 miles southeast of Stigler in Haskell County. One shaft was completed to a depth of about 1,415 feet; sinking of a second shaft began in June. Coal production from the mine was scheduled for May 1969. The Kerr-McGee mine (known as the Choctaw mine) will be the deepest coal mine in the United States.

Expansion activities of the coal industry in southeast Oklahoma revealed a shortage of miners with underground mining experience. The new mines will require about 700 workers. The Governor's coal council survey found only 200 experienced miners. To relieve the shortage, schools were established at Poteau Community College and at the Kerr-McGee mine to train miners for underground jobs. To date, 70 miners have graduated from the school at Poteau; classes began in October at the Kerr-McGee school. The miners were trained in mine safety, machine operation, rescue procedures, roof control, and ventilation. Machine operators received additional training.

Helium.—The Bureau of Mines plant at Keyes is the only helium extraction facility in Oklahoma. Total production at the plant was 308.6 million cubic feet, compared with the 1967 production of 309.1 million cubic feet. During 1968, sales of grade A helium from the plant totaled 228.7 million cubic feet valued at $8.0 million, based on the Bureau of Mines selling price of $35 per 1,000 cubic feet. In addition, 79.9 million cubic feet of helium, valued at $700,000, was transported by pipeline to Cliffside gasfield in Potter County, Tex., for underground storage.

Natural Gas.—Oklahoma ranked third in the Nation in natural gas production in 1968. The gas came from 8,059 wells in 64 counties, with Texas, Beaver, and Latimer Counties leading in production.

Proved recoverable reserves of natural gas in Oklahoma declined for the second consecutive year. Yearend reserves equaled approximately 11.8 cubic feet of gas for each cubic foot produced, compared with the 14.7:1 ratio for 1967. The AGA reported that new discoveries resulting from field and exploratory drilling added 171 billion cubic feet to the gas reserve.

Underground natural gas storage capacity in Oklahoma in January 1968 totaled 308.9 billion cubic feet; at yearend, 190.8 billion cubic feet of natural gas was in storage with 9.3 billion cubic feet of gas being added during the year.

A strong demand for natural gas in Midwest markets stimulated drilling in the Arkoma and Anadarko Basins of Oklahoma. Although fewer exploratory wells were drilled, total footage increased. Drilling targets were low-relief structures near the troughs of the basins. Average depth of the exploratory gas wells was 7,426 feet.

Table 6.—Marketed production of natural gas[1]

Year	Million cubic feet	Value (thousands)
1964	1,316,201	$166,747
1965	1,320,995	182,297
1966	1,351,225	189,172
1967	1,412,952	202,052
1968	1,390,884	197,506

[1] Comprises gas either sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in gas pipelines.

Skelly Oil Co. developed a discovery well in the Arkoma Basin, Pittsburg County, 18 miles southwest of McAlester. Production was from the middle Atoka Formation, Pennsylvanian age, through perforations from 8,358 to 8,466 feet. The well flowed 6.9 million cubic feet per day.

Important gas discoveries were made in Custer, Blaine, and Roger Mills Counties, in the Anadarko Basin. Aledo Field, in Custer and Dewey Counties, discovered in 1967, became productive with limited deliveries of 40 million cubic feet of gas per day to Panhandle Eastern Pipeline Co.; in 18 months, the rate will be raised to 180 million cubic feet of gas per day for the remainder of a 20-year contract. Aledo Field was expanded to 42 square miles by new drilling. In Blaine County, Seneca Oil Co. completed 1-Martin with a gasflow of 2.4 million cubic feet per day from 9,275 to 10,083 feet. Midwest Oil Co. completed

Table 7.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves, Dec. 31, 1967	Changes in proved reserves, due to revisions, extensions and new discoveries in 1968	Proved reserves, Dec. 31, 1968 (production was deducted)	Changes from 1967 (percent)
Crude oil..........thousand 42-gallon barrels..	1,458,948	153,700	1,394,653	—4.4
Natural gas liquids [1]..................do....	455,753	32,411	448,023	—1.7
Natural gas................million cubic feet..	19,403,806	516,841	[2] 18,368,265	[2] —5.3

[1] Includes condensate, natural gasoline, and LP gases.

[2] Change reflects net addition and withdrawals in storage.

Source: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. Proved Reserves of Crude Oil, Natural Gas Liquids and Natural Gas in the United States and Canada as of December 31, 1967. V. 22, May 1968.

Table 8.—Natural gas liquids production

(Thousand 42-gallon barrels and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	13,192	$34,011	20,972	$28,055	34,164	$62,066
1965	13,575	34,561	21,302	32,208	34,877	66,769
1966	13,717	35,715	23,482	44,381	37,199	80,096
1967	13,545	35,846	23,944	49,276	37,489	85,122
1968	13,905	38,829	25,497	39,520	39,402	78,349

1-F. M. Smith in Roger Mills County with a flow of 6.4 million cubic feet of gas per day through perforations at 8,306 to 8,320 feet.

Glover-Hefner-Kennedy Oil Co. continued drilling 1–1 Green in the trough of the Anadarko Basin in Beckham County; target depth of the well is below 24,000 feet. Phillips Petroleum Co. abandoned its 1–A Wesner in Washita County at a total depth of 23,534 feet.

Natural Gas Liquids.—A new record was established in output of natural gas liquids with the recovery of 1.7 billion gallons. Liquefied petroleum gases (LPG) and natural gasoline and cycle products were recovered; LPG accounted for 64.7 percent of the volume and 50.4 percent of the value. Eighty-five gas-processing plants were active in 1968, including four new plants that began operating during the year.

Shell Oil Co. completed a 75-million-cubic-foot-per-day (MMcfd) refrigerated-absorption processing plant at Seiling, Dewey County. Plant capacity was rated at 42,000 gallons of propane and 49,000 gallons of gasoline per day. Pan American Petroleum Corp. completed an 80-MMcfd refrigerated-absorption processing plant at Elmwood in Beaver County and a 34-MMcfd refrigerated-absorption processing plant at Hitchcock in Blaine County. Both plants will produce deethanized liquids. Sunray DX Oil Co. completed a 5-MMcfd processing plant at Wakita, Grant County, to recover propane, butane, and gasoline. Mustang Gas Products Co. contracted for construction of a 125-MMcfd gas-processing plant at Calumet, Canadian County, to extract propane, butane, and other liquefiable hydrocarbons. Mobile Oil Corp. was constructing a 12-MMcfd refrigerated-absorption processing plant at Taloga in Dewey County; completion is scheduled for April 1969.

The AGA reported that recoverable reserves of natural gas liquids at yearend were 448 million barrels, 7.7 million barrels less than the 1967 total. Exploratory drilling added 4.4 million barrels to the reserve and development drilling added over 95 million barrels through extensions and revisions in existing fields, but production exceeded total additions to reserves.

Yearend natural gas liquids storage capacity totaled about 2.6 million barrels. Caverns in a salt layer in Grant County comprise 59 percent of the total storage area. The remaining storage is in mined limestone and shale caverns, and salt beds in Kay, Creek, Beckham, Seminole, Tulsa, and Beaver Counties.

Petroleum.—Crude petroleum output totaled 223.6 million barrels compared with 230.7 million barrels in 1967. Production at yearend was obtained from 81,052 wells compared with 80,970 producing wells in 1967. Daily average production of crude oil per well per day was 7.5 barrels. Demand for Oklahoma crude oil continued strong throughout the year but the State's output declined in total production and in average daily production per well. Also, proved recoverable reserves of crude petroleum declined over 4 percent during the year, according to the API. The State ranked fourth in the Nation in proved reserves of petroleum.

In January 1968, the Interstate Compact Commission, in cooperation with the National Stripper Well Association, reported 56,839 stripper wells in Oklahoma. The wells produced 88.9 million barrels during the year ending January 1, 1968. Stripper well production accounted for about 39 percent of the State's 1967 production.

Table 9.—Crude petroleum production

(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value
1964	202,524	$587,320
1965	203,441	587,944
1966	224,839	654,281
1967	230,749	676,095
1968	223,623	668,202

Table 10.—Crude petroleum production, indicated demand, and stocks in 1968, by months

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Oklahoma
January	18,740	19,805	15,206
February	17,968	18,851	14,323
March	19,374	18,843	14,854
April	18,859	18,422	15,291
May	19,003	17,054	17,240
June	18,560	18,298	17,502
July	19,047	18,762	17,787
August	19,382	19,648	17,521
September	18,417	18,103	17,835
October	18,895	18,517	18,213
November	18,373	18,163	18,423
December	17,005	16,856	18,572
Total:			
1968	223,623	221,322	XX
1967	230,749	232,274	XX

XX Not applicable.

Allowable petroleum production was prorated by the Oklahoma Corporation Commission under the Interstate Oil Compact to maintain a balance between demand and production. In February, the Commission raised the 60-percent allowable to 75 percent of the basic depth-acreage formula. In December, the allowable rate was raised to 90 percent.

To further stimulate exploration and production, the Commission, at the request of the Oklahoma Independent Petroleum Association, raised the State's discovery allowable by 100 percent in July. The discovery allowable increase was the second in less than a year; in July 1967, the State's discovery allowable was raised by 200 percent. The 1967 and 1968 increases have boosted the allowable for 1,000-foot discovery wells from 20 barrels per day to 80 barrels per day. The effect of the 1968 increase on crude output has not been reported; however, the Commission noted that 12 new pools were added to the discovery list shortly after the allowable increase in July 1967.

Crude petroleum production was reported from 65 of the State's 77 counties. Stephens, Carter, Garvin, Osage, and Kingfisher Counties led in volume and value of output. Production from 65,829 unallocated wells (including discovery, secondary recovery, and stripper wells) accounted for 56 percent of the daily pipeline runs; the output of 15,223 allocated wells accounted for the remainder.

Waterflooding in the Healdton Field in Carter County continued. The project, operated by five companies, was expected to add 80 to 100 million barrels of crude oil to Oklahoma's recoverable reserves. Humble Oil & Refining Co. began secondary recovery by waterflood in the Hewitt Field, Carter County, in an attempt to recover 50 million barrels of crude petroleum in the next 23 years. Other waterflood projects adjoining Humble's project are Bradley Products Corp., in the West Hewitt Unit; W. T. and George Hale, Hewitt Field; and Texaco Inc., Hewitt-Hoxbar Unit, South of Humble's project.

The Hilltop Corp. started an experimental fireflood project in January in the Hilltop Field, Tulsa County. The fireflood was started inside a waterflood tract; air was injected at the rate of 750,000 cubic feet per day through a well that was originally drilled for the waterflood project. A gas burner, placed in the well for 4 days, injected about 33 million Btu's of heat. The success of the project was to be determined after 6 months of operation.

The State's refinery capacity at 14 plants was 464,250 barrels of crude oil per stream day at yearend. Construction during the year was limited to two plants—Continental Oil Co. plant in Ponca City, and Midland Cooperatives, Inc., plant at Cushing. Continental Oil Co. was installing a new methyl-ethyl-ketone solvent dewaxing and deoiling plant to replace outdated processing units. Capacity of the new plant will range from 1,280 to 2,116 barrels per stream day. Midland Cooperatives, Inc., was constructing a 70-ton-per-day delayed coking unit at the Cushing refinery.

NONMETALS

Nonmetallic mineral production from 58 of the State's 77 counties was valued at over $53 million, a 9-percent increase over 1967 value. Cement, clays, gypsum, stone, tripoli, and sand and gravel increased in

Table 11.—Oil and gas wells drilled in 1968, by counties

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Alfalfa	6	4	5	2	2	6	25
Atoka	-------	-------	-------	-------	-------	6	6
Beaver [1]	50	45	40	3	1	6	145
Beckham	2	3	1	-------	2	-------	8
Blaine	5	14	17	-------	2	4	42
Bryan	1	-------	-------	1	-------	3	5
Caddo	9	-------	5	-------	1	2	17
Canadian	-------	14	11	1	3	6	35
Carter	54	4	44	-------	-------	4	106
Cimarron [1]	15	1	10	-------	-------	3	29
Cleveland	4	-------	12	1	-------	8	25
Coal	4	3	4	-------	-------	2	13
Comanche	14	-------	8	-------	-------	4	26
Cotton	8	-------	10	-------	-------	2	20
Craig	-------	-------	2	-------	-------	1	3
Creek	103	2	20	-------	1	6	132
Custer	-------	7	4	-------	-------	1	12
Dewey	17	13	11	4	-------	5	50
Ellis	2	11	7	1	1	5	27
Garfield	96	13	12	4	-------	9	134
Garvin	33	1	27	-------	-------	21	82
Grady	14	5	7	-------	-------	5	31
Grant	5	-------	5	2	1	7	20
Greer	3	2	4	-------	1	1	11
Harper	1	20	22	-------	2	11	56
Haskell	-------	3	5	-------	2	2	12
Hughes	8	9	11	-------	3	7	38
Jackson	4	-------	-------	-------	-------	3	7
Jefferson	5	-------	10	-------	-------	10	25
Johnston	-------	-------	-------	-------	-------	1	1
Kay	54	1	29	5	-------	9	98
Kingfisher	127	3	5	6	1	3	145
Kiowa	-------	-------	8	-------	-------	6	14
Latimer	-------	7	5	-------	-------	-------	12
Le Flore	-------	16	4	-------	1	2	23
Lincoln	4	3	9	-------	1	18	35
Logan	16	2	8	2	-------	9	37
Love	9	-------	5	-------	-------	6	20
McClain	12	4	5	1	-------	3	25
McCurtain	1	-------	-------	-------	-------	-------	1
McIntosh	-------	4	-------	-------	1	2	7
Major	30	11	17	5	2	4	69
Marshall	1	1	3	-------	-------	3	8
Mayes	-------	-------	-------	-------	-------	1	1
Murray	-------	-------	1	-------	-------	5	6
Muskogee	9	-------	10	-------	-------	2	21
Noble	17	-------	8	3	1	6	35
Nowata	25	-------	4	-------	-------	-------	29
Okfuskee	12	2	16	-------	-------	2	32
Oklahoma	11	2	8	-------	-------	2	23
Okmulgee	38	1	16	-------	-------	1	56
Osage	102	8	54	2	1	9	176
Pawnee	30	1	16	-------	-------	7	54
Payne	19	2	21	1	-------	7	50
Pittsburg	-------	11	6	-------	2	9	28
Pontotoc	46	1	10	1	-------	5	63
Pottawatomie	14	-------	13	1	-------	3	31
Roger Mills	13	15	2	-------	-------	-------	30
Rogers	16	-------	2	-------	-------	-------	18
Seminole	45	-------	11	1	-------	4	61
Sequoyah	-------	1	-------	-------	-------	-------	1
Stephens	55	8	28	-------	1	6	98
Texas [1]	26	16	35	-------	2	8	87
Tillman	22	-------	-------	-------	-------	1	23
Tulsa	15	-------	9	-------	-------	-------	24
Wagoner	4	-------	5	-------	-------	-------	9
Washington	20	-------	4	-------	-------	-------	24
Washita	-------	-------	-------	-------	-------	3	3
Woods	17	17	11	1	-------	17	63
Woodward	2	19	13	-------	5	17	56
Total	1,275	330	715	48	40	331	2,739

[1] Oklahoma Panhandle.

Table 12.—Production of crude petroleum, by fields

(Thousand 42-gallon barrels)

Field [1]	1964	1965	1966	1967	1968
Allen	2,150	2,192	2,636	2,773	2,713
Apache	---------	1,518	3,102	4,287	4,545
Atlantic	1,363	1,190	998	---------	---------
Bowlegs	1,208	1,048	952	847	755
Burbank	13,417	12,017	10,655	8,795	7,537
Camrick	2,225	2,166	1,881	1,597	1,397
Cement	3,040	2,831	2,671	2,609	2,498
Cumberland	1,141	1,039	990	---------	---------
Cushing	3,075	3,110	3,499	3,978	4,565
Edmond, West	1,052	1,605	1,961	1,417	1,115
Enid, Northeast	2,148	2,143	2,196	2,170	1,480
Eola-Robberson	3,433	3,473	3,632	4,492	5,190
Garber	730	1,096	1,258	1,144	1,088
Glenn Pool	3,851	4,092	4,153	3,838	3,441
Golden Trend	14,292	13,544	13,440	12,952	11,961
Healdton	2,600	2,677	3,036	3,386	3,794
Hewitt	2,895	2,974	3,764	4,072	3,039
Knox	1,887	1,687	1,612	1,525	1,327
Loco	1,734	1,788	2,138	1,874	1,622
Moore, West	1,129	1,014	921	---------	---------
Muskogee	1,047	1,089	1,454	---------	---------
Naval Reserve	1,702	1,686	1,587	1,214	---------
Oklahoma City	2,112	1,978	1,922	1,941	1,963
Payne	1,969	1,722	2,076	2,338	2,113
Postle	1,752	2,105	3,307	4,502	6,210
Putnam	2,076	3,081	4,879	6,130	6,253
Ringwood	1,314	1,074	5,533	4,969	3,915
Seminole	968	1,122	1,115	1,025	979
Sho-Vel-Tum	26,660	28,769	30,712	32,232	32,611
Slick	1,114	1,180	1,147	---------	---------
Sooner Trend	---------	9,680	11,496	16,753	17,062
St. Louis	1,470	1,454	1,406	1,467	1,439
Stroud	1,161	1,151	1,220	1,239	1,133
Other fields	95,809	84,146	91,490	95,183	91,878
Total	202,524	203,441	224,839	230,749	223,623

[1] Based on The Oil & Gas Journal data adjusted to Bureau of Mines total.

value of output while lime, salt, and volcanic ash were the only nonmetals showing a decline in value in 1968. Minerals classified as nonmetals accounted for about 5 percent of the State's total mineral output value.

Cement.—Output of portland and masonry cement in Oklahoma gained during the year, principally because of increased building and highway construction in the State. Cement was produced in Mayes, Pontotoc, and Rogers Counties from three plants.

Clays.—Clay and shale for use in brick and tile products was mined by 11 companies. Fire clay and bentonite each had one producer. Total output of clays, including bentonite, showed a slight decline; value of output increased because of higher unit values.

Oklahoma Brick Corp. completed facilities to increase the capacity of the company's plant at Union City to 55 million brick per year. United Clay Pipe Co. began construction of a $2.5 million plant near Seminole; capacity will be 40,000 tons of clay pipe per year.

Table 13.—Clays sold or used by producers [1]

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	835	$854
1965	794	806
1966	745	754
1967	744	869
1968	726	967

[1] Excludes bentonite.

Gypsum.—Gypsum for use in wallboard, plaster, portland cement, and soil conditioning was mined in six counties by eight companies in 1968. All gypsum output in the State was produced by strip mining in the gypsum beds of Permian age that outcrop extensively in western and southwestern Oklahoma.

Lime.—Chemical-grade lime was produced at a plant in Sequoyah County. The lime was used in making chemical products, for water treatment, and in petroleum refining.

Salt.—Salt was produced by solar evaporation of brines from springs in Harmon County and by recovery of surface incrustations on the Big Salt Plain of the Cimarron River in Woods County.

The principal use of the State's salt output was in mineral mixtures for livestock, and in mixed livestock feed. Livestock mineral mixtures contain over 97 percent salt; all mixed livestock feeds contain 2 percent salt. Salt was also used in water systems to regenerate water soft-

Table 14.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	5,032	$6,031	1,648	$972	6,680	$7,003
1965	4,570	5,614	648	409	5,218	6,023
1966	4,329	6,151	1,711	1,414	6,040	7,565
1967	3,654	4,729	886	552	4,540	[1] 5,280
1968	4,283	5,691	758	595	5,041	[1] 6,288

[1] Data may not add to total shown because of independent rounding.

Table 15.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,534	$1,447	1,874	$1,894
Paving	654	625	927	888
Fill	365	133	345	201
Other [1]	896	2,215	932	2,337
Total	3,449	4,420	4,078	5,320
Gravel:				
Building	126	222	137	282
Paving	77	86	47	79
Other [2]	2	1	21	10
Total	205	309	205	371
Total sand and gravel	3,654	4,729	4,283	5,691
Government-and-contractor operations:				
Sand:				
Building	--------	--------	71	91
Paving	465	247	311	195
Other	--------	--------	8	6
Total	465	247	390	292
Gravel:				
Building	26	29	3	5
Paving	395	275	365	300
Total	421	304	368	305
Total sand and gravel	886	[3] 552	758	[3] 595
Grand total	4,540	[3] 5,280	5,041	[3] 6,288

[1] Includes railroad ballast, other construction sand, and industrial sand (unground and ground).
[2] Includes fill (1968) and other construction gravel.
[3] Data may not add to total shown because of independent rounding.

Table 16.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Granite		Limestone		Sandstone		Miscellaneous stone		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1964	3	$219	11,375	$12,669	1,271	$1,552	1,338	$647	13,987	$15,087
1965	6	503	13,121	14,771	2,057	2,092	1,233	705	16,417	18,071
1966	7	687	13,339	15,141	631	745	1,357	820	15,334	17,393
1967	12	949	13,543	15,594	1,248	1,469	1,552	920	16,355	18,932
1968	9	971	15,004	18,584	1,084	1,646	1,193	749	17,290	21,950

eners. In the petroleum industry, crude salt was used to control the salinity of drilling fluids.

Sand and Gravel.—Sand and gravel was produced in 41 counties during the year. A major part of the total output was mined in or near large metropolitan areas. Tulsa County, for example, led in production with over 1 million tons, while adjacent counties had little or no production. Output of sand and gravel increased 19 percent in value in 1968; most of the gain was in sand and gravel for commercial use. Construction contract awards by the State Highway Department and U.S. Army Corps of Engineers declined during the year; building permits (private nonresidential) increased 39 percent.

Yahola Sand and Gravel Co. at Muskogee, produced sand for use in the glass and foundry industries in addition to that for use in construction from sands of the Arkansas River. Treatment to remove impurities results in a feldspathic sand product.

Stone.—Value of stone produced during the year in 38 counties increased almost 16 percent, a record high. Limestone (including dolomite) output was responsible for the increase. Output of sandstone and granite decreased in quantity but increased in value because of higher unit prices; other types of stone decreased in both quantity and value.

Sulfur.—Sulfur was recovered from sour gas at a plant in Marshall County. The recovery rate increased during 1968.

Tripoli.—One mine in Ottawa County recovered tripoli for use in buffing compounds and in foundry processes. Output increased compared with that of 1967.

METALS

Copper.—Value of copper produced at the Eagle-Picher Industries, Inc., strip mine

Table 17.—Mine production of lead and zinc, in terms of concentrate and recoverable metals[1]

Year	Lead concentrate (galena)		Zinc concentrate (sphalerite)		Recoverable metal content[2]			
					Lead		Zinc	
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1964	3,730	$505	22,592	$1,963	2,781	$729	12,159	$3,307
1965	3,896	651	23,668	2,277	2,813	878	12,715	3,713
1966	4,181	649	21,086	2,002	2,999	907	11,237	3,259
1967	3,935	536	19,764	1,812	2,727	764	10,670	2,954
1968	3,455	509	12,850	1,108	2,387	631	6,921	1,869
1891–1968	1,703,845	166,589	9,886,917	495,212	1,305,277	199,710	5,214,604	793,757

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[1] Based on Oklahoma ore (dirt) and old tailing treated at mills during calendar year indicated.

[2] In calculating metal content of the ores from assays, allowance made for smelting losses of both lead and zinc. In comparing values of concentrate (ore) and metal, it should be noted that value given for concentrate is that actually received by producer, whereas value of lead and zinc is calculated from average price for all grades.

in Jackson County gained during the year. The copper ore was mined from Permian red beds and concentrated at the company mill near Creta. Concentrates were shipped to a smelter in El Paso, Tex.

Several mining companies were active in southwest Oklahoma during the year in exploration and development of "red bed" copper deposits. Lobaris Copper Co. of Ardmore, Okla., was constructing a mill on a lease in Greer County, south of Mangum. Mineral leases and options were taken on several thousand acres in Beckham, Garvin, Jackson, and McClain Counties by other interested companies.

Germanium.—Germanium was recovered at the Eagle-Picher Industries, Inc., processing plant near Quapaw, from residues accumulated at two of the State's zinc smelters.

Lead.—Output of lead declined in 1968; 23 operators produced lead from 29 mines compared with 25 operators and 47 mines in 1967. The decrease in output resulted from a decline in lead prices. The market started at 14 cents per pound in January and dropped to a low of 12.5 cents per pound in July; the yearend price was 13 cents per pound. The average value of Oklahoma lead concentrates was $147 per ton.

Silver.—The value of silver recovered from copper concentrates of the Eagle-Picher Industries, Inc., mine at Creta more than doubled in 1968.

Uranium.—Kerr-McGee Corp. began constructing a new uranium hexaflouride conversion plant west of Sallisaw, Sequoyah County. Employment at the plant is expected to exceed 300.

Table 18.—Tenor of lead-zinc ore milled and concentrates produced

	1967	1968
Total material milled short tons	442,858	275,475
Recovery of concentrate and metal from quantity milled:		
Galena short tons	3,935	3,455
Sphalerite do	19,764	12,850
Galena percent	0.89	1.25
Sphalerite do	4.46	4.66
Lead [1] do	0.62	0.87
Zinc [1] do	2.41	2.51
Average lead content of galena concentrate percent	70.70	70.44
Average zinc content of sphalerite concentrate percent	59.99	59.53
Average value per ton:		
Galena concentrate	$136.27	$147.35
Sphalerite concentrate	$91.69	$86.22

[1] Figures represent metal content of crude ore (dirt) as recovered in concentrate. Data on tailing losses not available.

Table 19.—Mine production of lead and zinc in 1968, by months, in terms of recoverable metals

(Short tons)

Month	Lead	Zinc
January	192	554
February	226	585
March	204	491
April	236	628
May	290	694
June	259	601
July	195	613
August	133	693
September	224	656
October	217	618
November	134	426
December	77	367
Total	2,387	6,921

Zinc.—Production of zinc was recorded from Century, Picher-Cardin, and Quapaw Districts in Ottawa County. Zinc was produced by 24 operators from 30 mines with output declining in excess of 35 percent because of the 13.5 cents per pound market price. Oklahoma zinc concentrates were valued at $86 per ton.

Eagle-Picher Industries, Inc., ceased pumping operations in the Picher field in November because of the high cost of maintaining the operations. Other operators will continue to pump some of the mines but with the limited pumping, life of the field is not expected to exceed 10 years as rising water will force closure of some of the mines.

Custom Mills and Smelters.—Three horizontal-retort zinc smelters were operated during the year. Zinc ores and concentrates were treated in smelters by American Metals Climax, Inc., at Blackwell; Eagle-Picher Industries, Inc., at Henryetta; and National Zinc Co., Inc., at Bartlesville. Eagle-Picher Industries, Inc., closed the Henryetta smelter late in 1968. National Zinc Co., Inc., began a $3 million expansion program at its plant in Bartlesville; new facilities will increase slab zinc capacity and add a 275-ton-per-day acid facility to the installed acid recovery unit. The plant will process zinc concentrates from the Tri-State District; most of the zinc concentrates smelted in 1968 were from Canadian sources. Rogers Galvanizing Co. announced plans for adding another unit

Table 20.—Mine production of lead and zinc concentrates in Tri-State District, in terms of concentrate and recoverable metals

Year	Lead concentrate (galena)		Zinc concentrate (sphalerite)		Recoverable metal content			
					Lead		Zinc	
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1964	5,333	$733	31,228	$2,732	3,966	$1,039	16,824	$4,576
1965	6,200	1,031	35,671	3,434	4,457	1,391	19,223	5,613
1966 [1]	5,755	891	29,997	2,851	4,108	1,242	16,006	4,642
1967 [1]	5,421	745	28,596	2,629	3,758	1,053	15,435	4,273
1968:								
Kansas	1,780	234	5,588	490	1,227	324	3,012	813
Southwest Missouri	31	4	76	6	22	6	41	11
Oklahoma	3,455	509	12,850	1,108	2,387	631	6,921	1,869
Total, 1968	5,266	747	18,514	1,604	3,636	961	9,974	2,693

[1] Excludes Southwest Missouri.

Table 21.—Tenor of lead and zinc ore milled and concentrates produced in the Tri-State District

	1964	1965	1966 [1]	1967 [1]	1968
Total material milled: Crude ore short tons	691,798	905,973	818,410	693,753	436,062
Recovery of concentrate and metal from material milled:					
Galena percent	0.77	0.68	0.70	0.78	1.21
Sphalerite do	4.51	3.94	3.67	4.12	4.25
Lead [2] do	0.57	0.49	0.50	0.54	0.83
Zinc [2] do	2.43	2.12	1.96	2.22	2.29
Average lead content of galena concentrate do	75.77	73.27	72.81	70.71	70.44
Average zinc content of sphalerite concentrate do	59.86	59.91	59.29	59.98	59.53
Average value per ton:					
Galena concentrate	$137.52	$166.32	$154.84	$137.46	$141.83
Sphalerite concentrate	$87.48	$96.28	$95.03	$91.95	$86.66

[1] Excludes Southwest Missouri; included in Missouri total.

[2] Metal content of the crude ore (dirt) as recovered in concentrate.

Table 22.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Dewey Rocky Mountain Cement Co.	Tulsa, Okla	Quarry and plant	Rogers.
Ideal Cement Co	Denver, Colo	do	Pontotoc.
Oklahoma Cement Co	Dallas, Tex	do	Mayes.
Clays:			
Acme Brick Co	Fort Worth, Tex	Mine and plant	Custer, Oklahoma, Tulsa.
Chandler Materials Co	Tulsa, Okla	do	Rogers, Oklahoma.
Filtrol Corp	Los Angeles, Calif	do	Dewey.
Frankoma Pottery Co	Sapulpa, Okla	do	Creek.
Mangum Brick Co	Mangum, Okla	do	Greer.
Oklahoma Brick Corp	Oklahoma City, Okla	do	Canadian, Custer.
Sapulpa Brick & Tile Corp	Sapulpa, Okla	do	Creek.
Superior Clay Products, Inc	Ada, Okla	do	Pontotoc.
Wewoka Brick & Tile Co	Wewoka, Okla	do	Seminole.
Coal:			
Bills Coal Co., Inc	Welch, Okla	Strip mine	Craig.
Evans Coal Co	McCurtain, Okla	Strip mine and auger	Haskell.
McNabb Coal Co	Catoosa, Okla	Strip mine	Rogers.
Garland Coal & Mining Co	Fort Smith, Ark	do	Haskell.
Howe Coal Co	Heavener, Okla	Underground	Le Flore.
Briartown Coal Co	Stigler, Okla	Strip mine	Muskogee.
Peabody Coal Co	St. Louis, Mo	do	Rogers.

Table 22.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Copper and silver: Eagle-Picher Industries, Inc.	Miami, Okla	Strip mine	Jackson.
Gypsum:			
Agricultural Gypsum Corp	Colony, Okla	Quarry	Washita.
Harrison Gypsum Co., Inc	Lindsay, Okla	do	Caddo.
Raymond Schweitzer Gypsum.	Okarche, Okla	do	Canadian.
Republic Gypsum Co	Lubbock, Tex	Quarry and plant	Jackson.
Texas Gypsum Co., Inc	Irving, Tex	Quarry	Comanche.
United States Gypsum Co	Southard, Okla	Quarry and plant	Blaine.
Universal Atlas Cement, Division of United States Steel Corp.	Pittsburgh, Pa	Quarry	Do.
Walton Gypsum Co	Homestead, Okla	do	Do.
Lead and zinc:			
Eagle-Picher Industries, Inc	Miami, Okla	Underground mine	Ottawa.
John Henderson	Picher, Okla	do	Do.
Marlene Ann Mining Co	do	do	Do.
The Quapaw Co	do	do	Do.
Tom Kiser	do	do	Do.
Contack Mining Co	Cardin, Okla	do	Do.
Lime: St. Clair Lime Co	Oklahoma City, Okla	Plant and quarry	Sequoyah.
Salt:			
Blackmon Salt Co	Freedom, Okla	Solar evaporation	Woods.
Salton Salt Co	Erick, Okla	do	Harmon.
Sand and gravel:			
Pennsylvania Glass Sand Corp.	Mill Creek, Okla	Stationary	Johnston.
The Dolese Co	New Castle, Okla	do	McClain.
Do	Guthrie, Okla	do	Logan.
Do	Dover, Okla	do	Kingfisher.
Do	Banner, Okla	do	Canadian.
Do	Enid, Okla	do	Garfield.
Midcontinent Glass Sand Co.	Roff, Okla	do	Pontotoc.
Sand Products, Inc	Del City, Okla	Stationary and dredge	Oklahoma.
Yahola Sand & Gravel Co	Muskogee, Okla	Stationary	Muskogee.
Bagby-Harris Sand Co	Tulsa, Okla	Dredge	Tulsa.
Shoffner Sand & Gravel Co	Broken Bow, Okla	Portable	McCurtain.
McMichael Concrete Co	Tulsa, Okla	Dredge	Tulsa.
Sober Bros. Sand & Gravel Co.	Ponca City, Okla	Stationary and portable	Kay.
City Concrete, Inc	Elmer, Okla	Stationary	Jackson.
Mohawk Rock & Sand Co	Tulsa, Okla	Portable and dredge	Tulsa.
Poage Sand Co	Guthrie, Okla	Dredge	Logan.
W. E. Steelman	Oklahoma City, Okla	Portable	Oklahoma.
Floyd L. Perryman, Inc	Shawnee, Okla	Dredge	Pottawatomie.
Tulsa Sand Co., Inc	Sand Springs, Okla	Stationary	Tulsa.
Do	Ralston, Okla	do	Pawnee.
Stone:			
Anchor Stone Co	Tulsa, Okla	Quarry	Tulsa.
Arkhola Sand & Gravel	Fort Smith, Ark	do	Cherokee.
The Century Granite Co., Inc.	Frederick, Okla	do	Johnston.
Chandler Materials Co	Tulsa, Okla	do	Tulsa.
Dolese Brothers Co	Oklahoma City, Okla	do	Caddo, Carter, Coal, Comanche, Kiowa, Murray, Pittsburg, Seminole.
Idabel Stone Co	Idabel, Okla	do	Various.
The Quapaw Co	Drumright, Okla	do	Creek, Okmulgee.
Sooner Rock and Sand Co	Oklahoma City, Okla	do	Murray.
Standard Industries, Inc	Tulsa, Okla	do	Kay, Mayes, Osage, Tulsa.
Trinity Concrete Products Co.	Dallas, Tex	do	Atoka.
Tulsa Rock Co	Tulsa, Okla	do	Tulsa.
Tripoli: The Carborundum Co., American Tripoli Division.	Seneca, Mo	Open pit	Ottawa.
Vermiculite: Texas Vermiculite Co.	Dallas, Tex	Exfoliating plant	Oklahoma.
Volcanic ash: Axtell Mining Corp.	Laverne, Okla	Open pit	Beaver.
Helium: U.S. Bureau of Mines	Amarillo, Tex	Keyes Plant	Cimarron.

Table 22.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Smelters:			
American Metals Climax, Inc.	Blackwell, Okla	Zinc	Kay.
American Smelting and Refining Co.	Sand Springs, Okla	do	Tulsa.
Eagle-Picher Industries, Inc.	Henryetta, Okla	do	Okmulgee.
Kaiser Chemicals, Inc	Tulsa, Okla	Magnesium	Tulsa.
National Zinc Co	Bartlesville, Okla	Zinc	Washington.
Petroleum refineries:			
Allied Materials Corp	Stroud, Okla	Refinery	Lincoln.
Apco Oil Corp	Cyril, Okla	do	Caddo.
Bell Oil & Gas Co	Ardmore, Okla	do	Carter.
Champlin Petroleum Co	Enid, Okla	do	Garfield.
Continental Oil Co	Ponca City, Okla	do	Kay.
Kerr-McGee Corp	Cushing, Okla	do	Payne.
Do	Wynnewood, Okla	do	Garvin.
Midland Cooperative, Inc	Cushing, Okla	do	Payne.
Okmulgee Refining Co., Inc	Okmulgee, Okla	do	Okmulgee.
Sequoyah Refining Co	Ponca City, Okla	do	Kay.
Sunray DX Oil Co	Duncan, Okla	do	Stephens.
Do	Tulsa, Okla	do	Tulsa.
Texaco Inc	do	do	Do.
Natural gas liquids:			
Champlin Petroleum Co	Fort Worth, Tex	Natural gas liquids processing	Garfield.
Cities Service Oil Co	Bartlesville, Okla	do	Kay.
Humble Oil & Refining Co	Tulsa, Okla	do	Kingfisher.
Mobil Oil Corp	Tologa, Okla	do	Dewey.
Phillips Petroleum Co	Bartlesville, Okla	do	Garvin, Oklahoma.
Shell Oil Co	Oklahoma City, Okla	do	Dewey.
Signal Oil & Gas Co	Ardmore, Okla	do	Carter.
Skelly Oil Co	Tulsa, Okla	do	Stephens.
Sun Oil Co	do	do	Harper.
Texaco Inc	do	do	Beaver.
Union Texas Petroleum, Division of Allied Chemical Corp.	do	do	Major.
Warren Petroleum Corp	do	do	Beaver, Garvin.

to its plant facilities in Tulsa. When the new unit is completed, the company will have four lines with a capacity for galvanizing 60,000 tons of steel per year.

Tri-State District.—Lead and zinc was produced by 36 operators from 39 mines in the Tri-State District of Kansas, Missouri, and Oklahoma. Output of lead and zinc declined during the year as a result of decreased market prices. The average value of lead concentrate produced in the district was $142 per ton. Zinc concentrate value averaged $87 per ton.

Eagle-Picher Industries, Inc., continued development work on the Swalley mine in Cherokee County, Kans. When development is completed, "sheetground" on the Swalley and Paxton leases will be mined at a rate of 3,000 rock tons per day.

The Mineral Industry of Oregon

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Oregon Department of Geology and Mineral Industries for collecting information on all minerals except fuels.

By Jerry J. Gray, [1] Gary A. Kingston, [2] and Mary Anne McComb [3]

The value of Oregon's mineral production in 1968 declined for the second consecutive year to $64.4 million from the record-setting $107.5 million figure of 1966. Decreases in demand for construction materials (clay, sand, gravel, and stone) had a major influence on the total mineral production value since this grouping constituted almost 70 percent of production value. In 1966, demand for these commodities was unusually high because a number of large dam projects were under construction concurrently. In 1967 and 1968, there were no comparable projects.

Demand for commercial sand and gravel rose 19 percent, in spite of a drastic tightening of the money market. If loanable funds had been more readily available for investment, commercial construction would have been greater.

The National Science Foundation awarded $553,000 to Oregon State University for the purpose of broad studies related to the seas. Matching funds of $500,000 were granted by the State. Some work was to be done in marine minerals and mining. The Bureau of Mines was working in a combined effort with the University testing "black sands" deposits off the Oregon and California coasts. These deposits are a potential source of chromium, gold, platinum, and other minerals.

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[1] Geologist, Bureau of Mines, Albany, Oreg.
[2] Physical scientist, Bureau of Mines, Albany, Oreg.
[3] Economist, Bureau of Mines, Albany, Oreg.

Table 1.—Mineral production in Oregon [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] ____ thousand short tons__	295	$295	213	$284
Diatomite ____ short tons__	108	2	120	W
Gem stones ____	NA	750	NA	750
Gold (recoverable content of ores, etc.) ____ troy ounces__	186	7	23	[3] 1
Lime ____ thousand short tons__	99	2,059	120	2,407
Mercury ____ 76-pound flasks__	943	461	938	502
Nickel (content of ore and concentrate) ____ short tons__	15,287	W	17,294	W
Peat ____ do____	W	W	360	11
Perlite ____ do____	8	(4)	--------	--------
Pumice and volcanic cinder ____ thousand short tons__	834	1,195	725	977
Sand and gravel ____ do____	19,630	25,250	18,260	21,457
Silver (recoverable content of ores, etc.) ____ troy ounces__	31	(3)	335	1
Stone ____ thousand short tons__	13,201	20,256	14,312	21,168
Talc and soapstone ____ short tons__	W	W	3	1
Value of items that cannot be disclosed: Cement, fire clay, copper (1968), lead (1968), and values indicated by symbol W_	XX	16,285	XX	16,890
Total ____	XX	66,560	XX	64,449
Total 1957–59 constant dollars ____	XX	63,442	XX	p 60,873

p Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes fire clay; included with "Value of items that cannot be disclosed."
[3] Based on average of the Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968, and the New York selling price for the remainder of the year.
[4] Less than ½ unit.

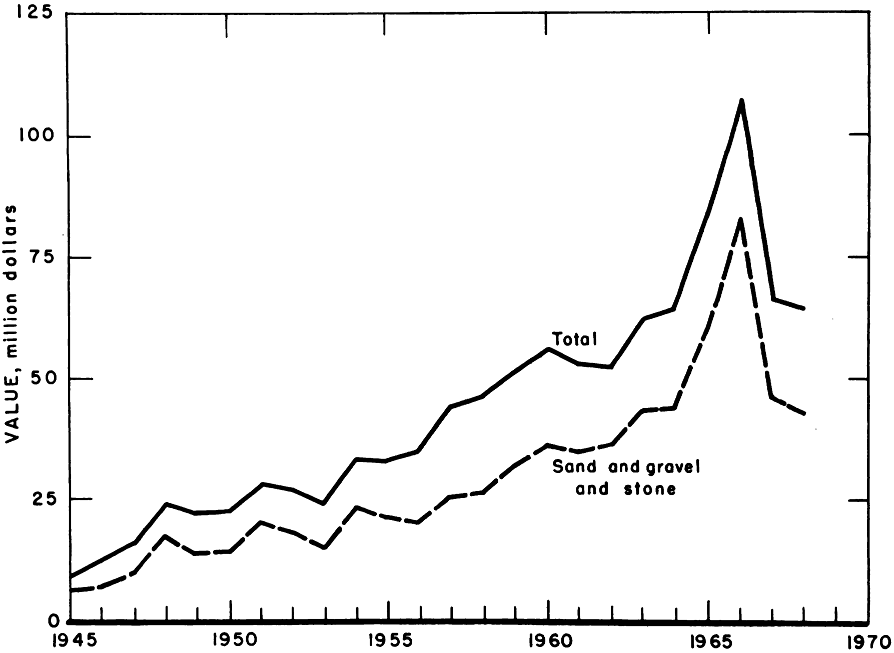

Figure 1.—Value of sand and gravel and stone, and total value of mineral production in Oregon.

Albany has become a center for the space age metals: Hafnium, columbium, zirconium, vanadium, and titanium. Wah Chang Albany Corp. produced 60 percent of the Nation's zirconium. Oregon Metallurgical Corp. supplied 13 percent of the titanium used in the United States, and was a major producer of high-purity vanadium. Other fabricators were TiLINE, Inc., and Rem Metals Corp.; the latter recently completing a $1.5 million expansion program. A new company, Zirconium Technology Corp., was formed. Growth in these industries had been substantial for the last 5 years and was projected to continue through 1985. For example, titanium market demand was expected to increase at an annual rate of 15 to 25 percent through 1970, and perhaps an annual rate of 25 percent thereafter.

Low-cost power provided an incentive for metal companies to locate in Oregon. Portland General Electric Co. awarded a $60 million contract for construction of a nuclear powerplant on the Lower Columbia River. Completion was expected in late 1974. Existing firms in the metals industry were expected to benefit.

Georgia-Pacific Corp. completed its gypsum research laboratory at the Tigard Industrial Park. Although most of the research was proprietary, studies were conducted on new product development, quality control, and manufacturing improvements.

The Oregon Supreme Court ruled against a sand and gravel company, stating that beds of navigable rivers have been held by the State for the people. The firm had been dredging the beds since 1933, but the court ruled that delay due to negligent officials did not alter the situation.

Construction Trends.—Oregon reflected the Nation's increased demand for residential housing. Employment in the construction industry rose only 2.3 percent, due almost completely to increased residential construction, as public projects have had no major influence on the industry since 1966.

Table 2.—Value of mineral production in Oregon, by counties

(Thousand dollars)

County	1967	1968	Minerals produced in 1968 in order of value
Baker	$5,985	$5,812	Cement, stone, lime, sand and gravel, clays, pumice, diatomite, copper, silver.
Benton	210	907	Sand and gravel, stone, clays.
Clackamas	7,574	11,439	Cement, stone, sand and gravel, clays.
Clatsop	19	W	Stone.
Columbia	W	1,068	Stone, sand and gravel.
Coos	686	500	Stone, sand and gravel, copper, silver, gold, lead.
Crook	237	191	Sand and gravel, stone, clays.
Curry	157	1,911	Stone, sand and gravel.
Deschutes	1,054	870	Pumice, stone, sand and gravel.
Douglas	9,730	9,295	Nickel, sand and gravel, stone, mercury, gold.
Gilliam	171	W	Stone, sand and gravel.
Grant	857	W	Sand and gravel, stone, mercury.
Harney	233	W	Stone, sand and gravel.
Hood River	364	206	Do.
Jackson	2,843	1,191	Stone, sand and gravel, gold.
Jefferson	133	235	Stone, sand and gravel, pumice, mercury.
Josephine	298	559	Sand and gravel, stone, soapstone, gold, silver.
Klamath	1,716	1,097	Sand and gravel, stone, pumice, clays.
Lake	808	722	Sand and gravel, pumice, stone, mercury.
Lane	7,890	6,944	Sand and gravel, stone, mercury.
Lincoln	484	444	Stone, sand and gravel.
Linn	534	609	Sand and gravel, stone.
Malheur	727	W	Lime, sand and gravel, mercury, stone.
Marion	571	649	Sand and gravel, stone, clays.
Morrow	69	53	Stone, sand and gravel.
Multnomah	6,748	7,448	Sand and gravel, lime, stone, clays.
Polk	1,129	411	Sand and gravel, stone, clays.
Sherman	236	191	Sand and gravel, stone.
Tillamook	263	415	Stone, sand and gravel, clays.
Umatilla	5,378	715	Stone, sand and gravel.
Union	445	W	Do.
Wallowa	W	308	Stone, sand and gravel, peat.
Wasco	146	W	Stone, sand and gravel.
Washington	2,441	2,054	Stone, sand and gravel, clays.
Wheeler	37	238	Sand and gravel, stone.
Yamhill	681	261	Sand and gravel, stone, clays.
Undistributed [1]	5,706	7,706	
Total	66,560	64,449	

W Withheld to avoid disclosing individual company confidential data.

[1] Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

Employment, Trade, and Markets.—According to figures published by the Oregon Department of Employment, alltime record highs for the civilian labor force, 935,600, and total employment, 899,600, were reached in August. The previous record monthly totals occurred in June. In the period 1960–68, total employment increased by 23.2 percent. After 2 years of instability, employment in Oregon reached seasonal adjustments more in line with those of the Nation, due largely to a broadened economic base. In 1959, the lumber industry employed 51.1 percent of total manufacturing employment, and in 1968, only 41.5 percent. Seventy percent of all manufacturing employment gains (in March alone, manufacturing was up 23 percent over the same period last year) were in the primary industries, and 25 percent of all manufacturing was in metal-connected industries. However, Oregon still had a 4.4 percent rate of seasonally adjusted unemployment, compared with a national rate of 3.6 percent. Part of this year's seasonal rate was due to record heavy rains occurring during harvest time, damaging important crops, and also limiting logging and sawmill production.

The University of Oregon Bureau of Business and Economic Research published two reports projecting the State's potential manufacturing markets and the influence of a diversified transportation system.[4]

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[4] Samson, Roy J. Transport Requirements for Pacific Northwest Economic Development. Oregon Bus. Rev., v. 27, No. 8, August 1968, pp. 1, 5, 6.

Shaffer, Leslie L. D. Factors Influencing New Manufacturing Companies To Locate in Oregon. Oregon Bus. Rev., v. 27, No. 1, January 1968, pp. 1–4.

Table 3.—Indicators of Oregon business activity

	1967	1968 p	Change (percent)
Employment and labor force, annual average:			
Total labor force thousands	859.1	879.6	+2.4
Unemployment do	41.3	38.6	—7.0
Construction do	30.2	30.9	+2.3
Lumber and wood products do	69.4	71.5	+3.0
Food products do	23.3	23.5	+.9
All manufacturing do	165.4	172.1	+4.1
All industries do	859.1	879.6	+2.4
Payrolls, factory millions	$1,133.8	$1,269.7	+12.0
Personal income:			
Total do	$6,122.0	$6,677.0	+9.0
Per capita	$3,090.0	$3,325.0	+7.6
Construction activity:			
Building permits millions	$268.9	(1)	XX
Heavy engineering awards do	$137.8	$149.9	+8.8
Value of highway contracts awarded do	$79.9	$54.0	—32.4
Expenditures on highway contract work do	$65.2	$59.2	—9.2
Cement shipments to and within Oregon thousand 376-pound barrels	3,415.1	3,617.6	+5.9
Farm marketings cash receipts millions	$523.6	$506.6	—3.2
Mineral production do	$66.6	$64.4	—3.3

p Preliminary. XX Not applicable.

[1] Data no longer available, see text.

Sources: Survey of Current Business, Construction Review, Pacific Builder & Engineer, State Highway Commission, and State Employment Department.

Table 4.—Employment and payrolls in mineral-industry establishments subject to Oregon unemployment-compensation law, by industries

Industry	1967		1968	
	Average annual employment	Total payrolls (thousands)	Average annual employment	Total payrolls (thousands)
Mining	1,647	$13,261	1,566	$12,410
Stone, clay, and glass products:				
Glass products	455	3,321	409	3,344
Hydraulic cement	326	2,643	264	2,314
Structural clay products	125	727	132	765
Concrete, gypsum, and plaster products	2,063	15,763	2,019	16,371
Cut-stone, stone, and pottery products	67	397	67	447
Miscellaneous	102	590	103	645
Total [1]	3,138	23,442	2,995	23,886
Primary metals:				
Blast furnaces, steelworks, rolling and finishing mills	1,134	10,208	1,210	11,261
Primary smelting and refining of nonferrous metals	2,868	23,692	2,914	25,486
Iron and steel foundries	2,157	16,620	2,266	18,164
Nonferrous foundries	585	4,131	635	4,982
Secondary smelting and refining of nonferrous metals and miscellaneous industries	271	2,121	214	1,665
Total [1]	7,015	56,771	7,238	61,558
Industrial chemicals	549	4,339	553	4,561
Petroleum refining and related products	401	2,849	430	3,125
Grand total [1]	12,750	100,662	12,782	105,540

[1] Data may not add to totals shown because of independent rounding.

Source: Oregon Employment Department. Industries may vary from those in the Bureau of Mines canvass.

Table 5.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Nonfatal	Injury rates per[1] million man-hours: Frequency	Injury rates per[1] million man-hours: Severity
1967:								
Coal and peat	9	86	1	6	-------	-------	--------	--------
Metal	150	203	30	245	-------	11	44.91	1,821
Nonmetal	146	165	24	194	-------	2	10.29	1,425
Sand and gravel	2,144	206	441	3,384	-------	74	21.87	441
Stone	1,117	237	265	2,102	1	59	28.54	3,426
Total	3,566	213	761	5,932	1	146	24.78	1,588
1968: p								
Coal and peat	5	164	1	7	-----	1	152.09	760
Metal	140	180	25	201	-------	4	19.87	760
Nonmetal	100	185	19	148	-------	5	33.73	11,058
Sand and gravel	1,545	211	326	2,611	2	64	25.28	5,162
Stone	1,025	250	256	2,052	-------	62	30.21	1,079
Total	2,815	223	627	5,019	2	136	27.49	3,485

p Preliminary.

Table 6.—Office of Minerals Exploration contracts active during 1968

County and contractor	Commodity	Contract: Date	Contract: Total amount	Contract: Government participation, percent
Baker: Ramsey, Ramsey, & Ramsey (Argonaut claim).	Gold, silver	Oct. 6, 1967	$34,550	75

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasives and Roofing Granules.—Granulated slag for airblasting purposes, especially for nonrecoverable applications such as cleaning ship hulls, continued to be dried, screened, and bagged by Mining Mineral Manufacturing Co., Riddle, and Pacific Abrasive Supply, Portland. Unprocessed material for the Riddle plant was obtained from the nearby Hanna Nickel Smelting Co. operation. The Portland plant was supplied with slag from an abandoned copper smelter site at Grand Forks, British Columbia, Canada. Production of roofing granules at the Pioneer Division, Flintkote Co., Portland, remained at about the 1967 level. The source of raw material for the roofing granules was purchased river sand.

Cement.—The only cement producer in the State, Oregon Portland Cement Co., operated its Lime, Baker County, and Lake Oswego, Clackamas County, cement plants at slightly lower rates than in 1967. Lone Star Cement Corp. opened a new cement distribution terminal in Portland. The facilities included a 5,500-barrel storage silo and truck loading equipment. The company also planned to add other equipment to receive and ship cement by water.

Destinations of shipments were chiefly within the State; out-of-State shipments were made to Washington, Idaho, and northern California. Shipments of portland cement were distributed to ready-mixed concrete companies, 72.4 percent; to concrete-product manufacturers, 10.7 percent; to highway contractors, 9.6 percent; to general contractors, 3.8 percent; to building material dealers, 3.3 percent; and to Federal, State, and local government agencies, 0.2 percent. Trucking, the principal method of transportation, accounted for 88 percent of the portland cement shipped; the remainder went by rail. The ratio of bulk to paper-bag shipments was about 12 to 1.

Combined shipments from three plants in Oregon and Nevada were 3.8 million barrels (376 pounds each) of finished portland cement; the same plants shipped 3.5 million barrels in 1967. The average value of portland cement shipped from these plants was $3.58 per barrel, f.o.b. plant, compared with $3.61 in 1967.

Clays.—Clay or shale sold or used by producers declined 28 percent from that of 1967. The major cause of the decrease was partial replacement of clay and shale by other siliceous materials for use in manufacturing cement, 87 percent; lower production of bloating shale used for lightweight-concrete aggregate and pozzolan contributed 9 percent to the decrease; and lower production of heavy-clay-products clay accounted for the remainder. Bentonite output increased 28 percent; however, this positive effect on the overall decline amounted to less than 1 percent.

Shale for cement manufacture was produced by Oregon Portland Cement Co. from its Nelson quarry, Baker County. Empire Lite-Rock, Inc., produced expandable shale, for conversion to lightweight-concrete aggregate and pozzolan, from its Banks pit, Washington County. Miscellaneous clay, for making heavy clay products, was produced at operations in Benton, Clackamas, Klamath, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill Counties. Willamina Clay Products Co., Inc., one of Yamhill County's producers of miscellaneous clay, also produced fire clay. Both clays were used for building brick. Central Oregon Bentonite Co. increased production from its Silver Wells and Sands pits, Crook County, because of greater demand for its use in rotary-drilling mud, a binder in stock-feed pellets, and a sealer for irrigation projects. Mandrones Mining Co., Inc., Clackamas County, mined, dried, processed, and packaged a carbonaceous shale for use as a soil conditioner and as an animal-feed supplement. A small coal seam within the shale bed was handpicked to fire a dryer.

Diatomite.—Output of diatomite increased 11 percent compared with that of 1967, even with the cessation of activity at a Baker County deposit. A. M. Matlock, the only producer, increased sales and production by developing a market for diatomite as an extender in plywood glue. Most of the diatomaceous earth mined from his deposit near Silver Lake in Lake County was trucked to Eugene for processing into pet litter.

Gems and Gem Materials.—Production of gems and gem materials was concentrated in the Lebanon, Nyssa, and Prineville areas. Most of the output was by a large number of amateur recreation miners, both local enthusiasts and tourists. The owners of agate fee-digging sites near Lebanon organized to form the Lebanon Agate Association to take advantage of group publicity. The gemstone beds cover 200 acres and have yielded opal, opalized and agatized wood, carnelian, dendrite, and "picture" rock.

A report was published which described a petrified wood locality scheduled to be flooded by an Army Corps of Engineers dam at Holley, Linn County. The study theorized on the origin of the fossil woods and gave information on how to identify the various kinds of woods.[5]

A giant thunderegg (agate-filled nodule —Oregon's State rock), weighing an estimated 3,500 pounds, was found in the Deschutes gorge south of Maupin. The 4- by 5-foot egg was donated to the State for a permanent display on the Capitol grounds in Salem.

Lime.—A record high output was registered, with a gain of 21 percent over that of 1967 and with a 3-percent gain over the last record year of 1966. Quicklime and hydrated lime were produced by four companies. Shipments were made to the Pacific Northwest; California; British Columbia, Canada; and South Vietnam.

The major markets for quicklime were the calcium carbide, sugar, pulp and paper, and metallurgical industries. Hydrated lime was supplied for plywood manufacture and water purification. Ash Grove Lime & Portland Cement Co., Portland, and Chemical Lime Co., Baker, produced lime for the commercial markets. Lime for calcium-carbide manufacturing and sugar refining was produced and used by Pacific Carbide & Alloys Co., Portland, and Amalgamated Sugar Co., Nyssa, respectively. Limestone barged from Texada Island, British Columbia, Canada, was used by the two Portland plants, and the other two were supplied from local limestone quarries. Lime (189,000 tons) was regenerated from recycled calcium-carbonate sludge at four pulp mills.

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[5] Gregory, Irene. The Fossil Woods Near Holley in the Sweet Home Petrified Forest, Linn County, Oregon. Ore Bin, v. 30, No. 4, April 1968, pp. 57–76.

Perlite.—Del T. Harmon and A. M. Matlock stockpiled, for testing purposes, small tonnages of perlite from deposits in Baker and Lake Counties, respectively. Crude perlite from Nevada was expanded at the Portland plant of Supreme Perlite Co. The expanded product was used mainly as a lightweight-plaster aggregate; smaller quantities were sold for concrete aggregate, soil conditioning, and loose-fill insulation.

Pumice and Volcanic Cinder.—The quantity of pumice and pumiceous materials (volcanic cinder and scoria) sold or used by Oregon producers was 13 percent less than in 1967. Output, 72 percent, was used mainly unprocessed for road construction and maintenance by governmental agencies; smaller amounts were processed and used for lightweight-concrete aggregate, roofing, landscaping, concrete admixture (pozzolan), and as an abrasive. Road material was produced in Deschutes, Jefferson, Klamath, and Lake Counties. Pumice processed and sold to concrete-products plants in the Northwestern States, California, and Canada was produced by Central Oregon Pumice Co. and Graystone Corp., Deschutes County. Volcanic cinder from Baker County was mined and crushed by Oregon Portland Cement Co. for use as pozzolan.

Sand and Gravel.—Output and value of sand and gravel fell 7 and 15 percent, respectively, compared with totals for 1967. This level of production resulted from two opposing 3-year trends. Commercial production had increased from 10.1 million tons in 1966 to 10.6 million tons in 1967, and to 12.5 million tons in 1968. Government-and-contractor (largely contractor production for Federal, State, County, and municipal agencies) production on the other hand had decreased from 25.3 million tons in 1966 to 9.1 million tons in 1967, and to 5.8 million tons in 1968. All categories of Government-and-contractor production had losses; however, the State had the greatest loss because of less highway work. Output for Federal agencies decreased from 4.2 million tons (1967) to 3.5 million tons; output for State agencies decreased from 3.6 million tons to 1.3 million tons; and output for counties decreased from 1.3 million tons to 1.0 million tons.

Production was reported from 35 of 36 counties; the exception was Clatsop County. Output exceeding 5 million tons was reported from Lane County, over 4 million tons from Multnomah County, and over 1 million tons from Clackamas County.

Table 7.—Sand and gravel sold or used by producers, by classes of operation and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	3,636	$4,706	4,442	$5,361
Road material	5,931	7,178	6,235	7,650
Fill	804	530	1,193	848
Other [1]	180	186	615	687
Total	10,551	12,600	12,485	14,546
Government-and-contractor operations:				
Building	226	336	221	290
Road material	5,744	9,982	2,968	4,210
Fill	161	116	110	69
Other [1]	2,948	2,216	2,476	2,342
Total	9,079	12,650	5,775	6,911
All operations:				
Building	3,862	5,042	4,663	5,651
Road material	11,675	17,160	9,203	11,860
Fill	965	646	1,303	917
Other [1]	3,128	2,402	3,091	3,029
Grand total	19,630	25,250	18,260	21,457

[1] Includes special sands, sand and gravel used for railroad ballast and miscellaneous purposes.

Stone.—Output and value of stone rose 8 and 5 percent, respectively, above totals for 1967. The increase was due to two State highway department projects in Clackamas County. Basalt, used for roadstone, ballast, riprap, cement and asphalt concrete aggregate, and fill, continued to be the principal stone quarried, accounting for 94 percent of the total. Limestone production dropped to its lowest level in 15 years because of decreased use of limestone for roadstone. The largest limestone industrial market was the cement industry, followed by the sugar, lime, paper, agricultural, and metallurgical industries. Limestone was quarried in Baker County by Chemical Lime Co. at its Baboon Creek quarry and by Oregon Portland Cement Co. at its Durkee quarry. Limestone for roadstone was produced by the Curry County road department.

Sandstone and quartzite output increased to 198,000 tons, because Oregon Portland Cement Co. developed a new quarry in a weathered sandstone on Gnat Creek in eastern Clatsop County. The material, used for its silica content in cement production, was trucked to the Columbia River at Wauna and then barged to the firm's Lake Oswego plant. Quartz (silica) was produced by Bristol Silica Co., Jackson County. The material was transported about 4 miles by truck to a screening plant at Gold Hill. Sized material was marketed for use in making ferrosilicon and silicon carbide.

Stone was produced from operations in all of the 36 counties; output exceeded 2 million tons in Clackamas County and 1 million tons in Washington County.

A report describing the Pioneer Construction Co. Portland stone operation appeared in the February issue of Pit and Quarry.[6]

Talc and Soapstone.—John C. Pugh mined and shipped 3 tons of soapstone from a deposit in Josephine County. The material was used for sculpturing purposes by educational institutions.

Stauffer Chemical Co. ground 14 percent more soapstone than in 1967. The Portland plant was supplied from mines in northwestern Washington. The finished product was used as a carrier and diluent in pesticides.

Vermiculite (Exfoliated).—Output of expanded vermiculite from two Portland plants was 29 percent higher than that of 1967. Vermiculite-Northwest, Inc., obtained crude vermiculite from Montana, while Supreme Perlite Co. used material from the Republic of South Africa. The exfoliated product was marketed mainly for loose-fill insulation and lightweight aggregate for plaster and concrete; smaller quantities were used for soil conditioning and fertilizer carrier.

METALS

Aluminum.—Production of primary aluminum increased 3.7 percent compared with that of the previous year.

Harvey Aluminum, Inc., The Dalles Wasco County, produced nearly 91,000 tons of aluminum during the fiscal year ending September 30. The 500-acre plant site housed facilities for producing aluminum pig and ingot, sheet ingot, redraw rod, and extrusion billets. A company-owned alumina plant at Isle of St. Croix, U.S. Virgin Islands, was the principal source of alumina reduced to aluminum at The

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[6] Trauffer, Walter R. Portland, Oreg., Stone Plant Makes Wide Range of Products. Pit and Quarry, v. 60, No. 8, February 1968, pp 134–144.

Table 8.—Stone sold or used by producers by uses

(Thousand short tons and thousand dollars)

Use	1967		1968	
	Quantity	Value	Quantity	Value
Concrete and roadstone	10,992	$16,115	12,434	$16,329
Railroad ballast	237	343	174	265
Riprap	1,234	2,346	813	2,521
Other [1]	737	1,452	891	2,053
Total [2]	13,201	20,256	14,312	21,168

[1] Includes building stone (dimension), stone used at cement, paper, and chemical plants; sugar refineries; rockfill; dams; dikes; and for miscellaneous unspecified purposes.
[2] Data may not add to totals shown because of independent rounding.

Dalles. The alumina plant had a capacity of 350,000 tons annually, and received its bauxite from Australia and from a Harvey mining operation in the Republic of Guinea. Calcined petroleum coke used at The Dalles came from a wholly owned subsidiary, Watson Carbon and Chemical Co., Wilmington, Calif. Hard pitch, aluminum fluoride, fluorspar, and soda ash were purchased from domestic suppliers. Cryolite and cathode electrodes were purchased from foreign sources. Aluminum output went to company-owned semifabricating plants in Torrance, Calif., Adrian, Mich., and Lewisport, Ky., and to customers throughout the United States.

Employment at The Dalles averaged 470. Electric power sufficient for continuous operation at total plant capacity was supplied under contract with Bonneville Power Administration (BPA); energy purchase totaled 1,595 million kilowatt-hours at a cost of $0.00171 per kilowatt-hour.

Reynolds Metals Co. announced that a new 40,000-ton-per-year potline would be added at its Troutdale plant, Multnomah County; completion was expected by early 1971. Existing reduction plant capacity was 100,000 tons annually. Some 800 were employed at the plant. Electricity purchased from BPA at a cost of $0.00207 per kilowatt-hour totaled 1,544 million kilowatt-hours.

Copper.—A small tonnage of copper was mined from two properties: the Bolivar, Coos County, and the Copper Queen, Baker County.

Bear Creek Mining Co. (Kennecott Copper Co. subsidiary) and Cyprus Mines Corp. drilled properties in eastern Baker County. Bear Creek operated one drill rig throughout the summer and into early fall, and Cyprus worked two rigs from March until November. Both companies were expected to continue exploration, subject to evaluation of completed drilling. Cyprus gave up leases in the Mother Lode area but retained ground in the Sparta district.

Ferroalloys.—The Union Carbide Co., Portland, produced low-iron and standard ferromanganese and silicomanganese. Manganese ore consumed came largely from Brazil and was supplemented by ore purchases from the General Services Administration stockpile. Total furnace capacity was directed to manganese alloy products, which excluded output of ferrosilicon. Plant employment was 120 persons. BPA sold Union Carbide 143 million kilowatt-hours of electricity for $0.00223 per kilowatt-hour.

Ferronickel was produced by the Hanna Nickel Smelting Co., Douglas County (see Nickel); the Hanna company also produced ferrosilicon for use in the nickel recovery process.

National Metallurgical Corp., subsidiary of Kawecki Berylco Industries, Inc., continued to produce silicon metal at Springfield, Lane County.

Gold and Silver.—Twenty-three ounces of gold was produced in the State (7 ounces from placer mining and 16 ounces from lode mining).

Omega Mining Co., Ltd., Vancouver, British Columbia, Canada, holding approximately 1,500 acres of mining claims in the Bourne area of Baker County, announced a major mining program to extract gold-silver ore from the Columbia Lode which traverses the area. Old mines encompassed in the Omega holdings include the North Pole, E & E, Golconda, and Tabor Fraction, all in the Cracker Creek mining district. A mill was to be constructed with a capacity of 1,000 tons per day. Omega had been exploring the area for about 3 years. Exploration, costing an estimated $1.5 million, was to continue.

A placer property was being developed on Pine Creek, Baker County, by Cornucopia Placer Co.

The State of Oregon Department of Geology and Mineral Industries published a report on gold and silver in Oregon.[7]

Iron and Steel.—Iron ore to be processed by Oregon Steel Mills at a new plant being constructed in Portland will be shipped from Peru as a 71-percent-iron slurry. The benefits of a slurry were stated to be easier handling and a reduction of ore fines loss.

Construction began on the Cascade Steel Rolling Mills, Inc., plant at McMinnville. The firm was to produce steel reinforcing bar and angle products. Capacity was to be 50,000 tons of steel annually, and employment was expected to reach 200.

Mercury.—Output totaled 938 flasks (each containing 76 pounds of mercury) in 1968, nearly the same as that for the previous year. Continuation of a high average price ($535.56 per flask), compared with years prior to the more recent period, encouraged producers to extract the metal from previously marginal and submarginal sources, but mining at the Bretz property in Malheur County apparently exhausted available ore at the existing price, and the operation was closed in early November. The mine was worked by Amzco Corp. under lease from the owner, New Idria Mining and Chemical Co., Fresno, Calif. Ore averaging 1 to 2 pounds mercury per ton was concentrated by flotation at the Bretz mill before being treated in an adjacent furnace plant. The Glass Butte mine, Lake County, was closed in September by Jackson Mountain Mining Co. after depleting available reserves. In the same area, Merco Development Co. worked the Polaris claim. Black Butte Mining Inc., produced throughout the year at the Black Butte mine, Lane County, and was the State's largest single producer. Other active operations included Alcona Mining, Inc.'s Elkhead property in Grant County, Canyon Creek Mercury Mines' Canyon Creek mine in Grant County, and the Whiting prospect, Horse Heaven district, in Jefferson County.

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[7] Brooks, Howard C., and Len Ramp. Gold and Silver in Oregon. State of Oregon Dept. of Geol. and Min. Ind., Bull. 61, 1968, 337 pp.

Nickel.—Hanna Mining Co. mined 1,217,906 tons of 1.42 percent nickel (17,294 tons) laterite ore at the Nickel Mountain mine, Douglas County. At the nearby Hanna Nickel Smelting Co. smelter, 13,127 tons of nickel was recovered in 25,835 tons of ferronickel. This was the full capacity of the smelting plant. Ferrosilicon, used in the metallurgical process to recover the nickel from the ore, was produced at the smelter from silica rock produced by Bristol Silica Co. Jackson County; iron ore from Nevada; and iron turnings purchased from various west coast scrap dealers. Production of 48-percent-silicon ferrosilicon alloy was 21,490 tons. Mine and smelter employment averaged 475. The largest market for the ferronickel product was stainless steel producers located in the Eastern United States. Demand for the product was good in the face of a general nickel supply shortage that was projected to continue until 1972 or 1973, subject to market fluctuations in the steel industry. The yearend price quotation was $1.005 per pound of nickel in ferronickel. BPA electric energy sales to the Hanna company were 710 million kilowatt-hours at a cost of $0.00223 per kilowatt-hour.

Titanium.—Oregon Metallurgical Corp. (OREMET), Albany, completed construction of an ingot melting plant, capable of producing ingots 30 inches in diameter, which increased ingot capacity to approximately 17 million pounds annually. Advancement was made in engineering for backward integration of the titanium sponge plant.

Major sources of sponge metal were England and Japan; the balance of requirements came from Russia and OREMET sponge reduction. Some titanium metal was derived from scrap. Eighty-eight percent of OREMET's sales consisted of ingot, and the remainder was titanium and zirconium castings. Ingots were sold to forging companies, and castings went primarily to the chemical process industry. OREMET employed 200 to 225 people. Production declined from that of the previous year, but the company's share of the ingot market remained substantially unchanged at an estimated 11 to 13 percent.

TiLINE, Inc., Albany, completed construction of its titanium and zirconium casting plant. Melting furnace capacity was sufficient to allow production of 1,000-pound castings and with modification, up to 2,000-pound castings. Initial production was in pumps and valve components. Employment was approximately 20.

Rem Metals Corp., Albany, completed building construction and planned equipment installation during the first half of 1969, thereby completing the company's $1.5 million expansion program. Rem specialized in precision investment castings of titanium, zirconium, and columbium metal. Employment was approximately 50 persons.

Uranium.—Gulf Oil Corp., Nuclear Fuels Division, conducted reconnaissance geology over an extensive area in southeastern Oregon. Little is known about the complex geology of the area. Work was confined to field mapping, stratigraphic studies, and drilling for confirmation of geologic evidence. Previously leased land was relinquished in Crook, Grant, and Wheeler Counties; about three-fourths of the original acreage was retained and is in Harney, Lake, and Malheur Counties.

Western Nuclear, Inc., was doing exploration drilling at the White King mine, Lake County. Drilling was halted in August in favor of using the equipment on another project, but it was indicated that exploration was to be resumed at a later date.

Atlantic-Richfield Co. purchased the uranium plant at Lakeview and was determining the necessary work and investment to make the plant operable. The company made an aerial reconnaissance for radioactivity of the southeastern section of the State.

Zirconium.—Wah Chang Albany Corp. processed Australian zircon sand to recover zirconium and hafnium metal. The separation plant capacity was increased in January to approximately 300 tons per month of combined zirconium-hafnium oxide. The zirconium reduction plant capacity reached 150 tons per month of sponge metal, and arc melting and fabrication capabilities were increased accordingly. Wire was added to the product line manufactured at the plant. At yearend, employment totaled 1,075 compared with 950 at the same time in 1967. A large order was received from General Electric Co. for zirconium billet, bar, strip, tube, sheet, and other shapes for use in nuclear reactors.

Seamless titanium and zirconium tubing was to be produced by a new company, Zirconium Technology Corp., in a plant to be built at Albany. Initial employment was projected to be 50 persons.

MINERAL FUELS

Asphalt.—Union Oil Co., California, at midyear placed into operation a $1.5 million asphalt refinery. The Portland plant was highly automated with electronically controlled blending of various grades of asphalt and metered loading of specified quantities into trucks. Cascade Construction Co. in June dedicated a new $1.5 million asphalt concrete mixing plant. The new Portland plant with a capacity of 620 tons per hour replaced a 200-ton-per-hour plant at the same site. The firm, organized in 1921, had produced an estimated 2.5 million tons of bituminous mix equal to 2,500 miles of single-lane highway.

Natural Gas.—By June, Northwest Natural Gas Co. had completed a $3.5 million liquefied natural gas plant. The Portland facility was the first in the Pacific Northwest and only the second on the Pacific Coast. The firm was to purchase natural gas in summer months, cool it until it became liquid and occupied a much smaller space, and store it in a 117-foot-diameter tank until required in winter months. The tank was designed to store 175,000 barrels of liquefied natural gas, the equivalent of 620 million cubic feet in the vapor state.

Peat.—A peat bog operated by Wes Cruikshank near Enterprise, Wallowa County, yielded lower quantities than in 1967.

Petroleum.—No new drill footage was recorded for Oregon. By yearend, all offshore leases except two owned by Union Oil Co. had been dropped. Oregon Department of Geology and Mineral Industries issued one drilling permit to R. F. Harrison of Seattle, Wash., to deepen the Central Oils, Inc., "Morrow 1" in Jefferson County. Central Oils, Inc., took out a deepening permit in 1966, but no new footage was drilled.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
NONMETALS			
Cement: Oregon Portland Cement Co	Portland, Oreg. 97200	Plant	Baker and Clackamas.
Clay:			
Central Oregon Bentonite Co	Prineville, Oreg. 97754	Pit and plant	Crook.
Ceramco, Inc	McMinnville, Oreg. 97128	do	Yamhill.
Columbia Brick Works	Portland, Oreg. 97200	do	Multnomah.
Corvallis Brick & Tile Co	Corvallis, Oreg. 97330	do	Benton.
Empire Lite-Rock, Inc	Portland, Oreg. 97200	do	Washington.
Klamath Falls Brick & Tile Co	Klamath Falls, Oreg. 97601	do	Klamath.
Mandrones Mining Co	Molalla, Oreg. 97038	Pit	Clackamas.
McMinnville Brick Co	McMinnville, Oreg. 97128	Pit and plant	Yamhill.
Monmouth Brick & Tile Co	Monmouth, Oreg. 97361	do	Polk.
Monroe Clay Products Co	Monroe, Oreg. 97456	do	Benton.
Needy Brick & Tile Co	Hubbard, Oreg. 97032	do	Clackamas and Marion.
Oregon Portland Cement Co	Portland, Oreg. 97200	Pit	Baker.
Scholls Tile Co	Hillsboro, Oreg. 97123	Pit and plant	Washington.
Tillamook Clay Works	Tillamook, Oreg. 97141	do	Tillamook.
Willamina Clay Products Co., Inc	Tigard, Oreg. 97200	do	Yamhill.
Diatomite: A. M. Matlock	Eugene, Oreg. 97400	Mine and plant	Lake.
Lime:			
Ash Grove Lime & Portland Cement Co.	Portland, Oreg. 97200	Plant	Multnomah.
Chemical Lime Co	Baker, Oreg. 97814	do	Baker.
Pacific Carbide & Alloys Co	Portland, Oreg. 97200	do	Multnomah.
Peat: Jewell's Sales & Service, Inc	Enterprise, Oreg. 97828	Mine	Wallowa.
Perlite (expanded): Supreme Perlite Co	North Portland, Oreg. 97043	Plant	Multnomah.
Pumice:			
Central Oregon Pumice Co	Bend, Oreg. 97701	Mine and plant	Deschutes.
Graystone Corp	Bend, Oreg. 97701	do	Do.
Chester Hiatt	Redmond, Oreg. 97756	do	Do.
Oregon Portland Cement Co	Portland, Oreg. 97200	Mine	Baker.
Parks Pumice Mining	Klamath Falls, Oreg	do	Klamath.
Roofing granules: Flintkote Co	Portland, Oreg. 97200	Plant	Multnomah.
Sand and gravel:			
Baker Rock Crushing	Hillsboro, Oreg. 97123	Pit and plant	Washington.
Bethel Danebo Sand & Gravel	Eugene, Oreg. 97400	do	Lane.
Builders Supply	Corvallis, Oreg. 97330	do	Benton.
DeAtley Corp	Baker, Oreg. 97814	do	Baker.
Delta Sand & Gravel	Eugene, Oreg. 97400	do	Lane.
Eugene Sand & Gravel	do	do	Do.
Glacier Sand & Gravel	Portland, Oreg. 97200	do	Multnomah.
McKenzie Sand & Gravel	Eugene, Oreg. 97400	do	Lane.
M. P. Materials	Salem, Oreg. 97300	do	Marion.
Milwaukie Sand & Gravel Co	Milwaukie, Oreg. 97222	Dredge and plant	Clackamas.
Rich Valley Top Soil Co	Oregon City, Oreg. 97045	Pit and plant	Do.
Roseburg Sand & Gravel	Roseburg, Oreg. 97470	do	Douglas.
Ross Island Sand & Gravel	Portland, Oreg. 97200	Dredge and plant	Multnomah.
Umpqua River Navigation Co	Reedsport, Oreg. 97467	do	Douglas.
Wildish Sand & Gravel	Eugene, Oreg. 97400	Pit and plant	Lane.
Willamette Hi-Grade Concrete Co	Portland, Oreg. 97200	Dredge and plant	Multnomah.
Stone:			
L. V. Anderson	Oakridge, Oreg. 97463	Quarry	Lane, Klamath, Jefferson.
Bristol Silica Co	Rogue River, Oreg. 97537	do	Jackson.
Chemical Lime Co	Baker, Oreg. 97814	do	Baker.
L. H. Cobb	Beaverton, Oreg. 97005	do	Washington.
Eckman Creek Quarries	Waldport, Oreg. 97394	do	Lincoln.
General Construction Co	Portland, Oreg. 97200	do	Columbia.
Groesbeck-Durbin, Inc	Springfield, Oreg. 97477	do	Wallowa.
E. H. Itschner Co	Molalla, Oreg. 97038	do	Umatilla.
Peter Kiewit Sons	Vancouver, Wash. 98600	do	Various.
Lockheed Shipbuilding & Construction Co.	Seattle, Wash. 98100	do	Lane.
Mobile Crushing Co	Eugene, Oreg. 97400	do	Do.
Morse Bros	Lebanon, Oreg. 97355	do	Various.
Oregon Portland Cement Co	Portland, Oreg. 97200	do	Baker, Clatsop.

Table 9.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
NONMETALS—Continued			
Stone—Continued			
Pioneer Construction Co	Portland, Oreg. 97200	Quarry	Multnomah.
Quality Rock Co	Beaverton, Oreg. 97005	do	Washington.
Arthur Simonsen Co	Baker, Oreg. 97814	do	Baker, Grant, Umatilla.
F. L. Somers, Inc	Medford, Oreg. 97501	do	Curry.
L. P. Stubblefield	Eugene, Oreg. 97400	Quarry	Benton, Lane, Linn.
Sunset Crushed Rock	Astoria, Oreg. 97103	do	Clatsop.
Weyerhaeuser Co	Longview, Wash. 98632	do	Clackamas.
Jed Wilson & Son	LaPine, Oreg. 97739	do	Deschutes.
W. W. D. Corp	Drain, Oreg. 97435	do	Douglas.
Talc and soapstone:			
John H. Pugh	Grants Pass, Oreg. 97526	Mine	Josephine.
Stauffer Chemical Co	Portland, Oreg. 97200	Plant	Multnomah.
Vermiculite (exfoliated):			
Supreme Perlite Co	North Portland, Oreg. 97043	do	Do.
Vermiculite-Northwest, Inc	Auburn, Wash. 98002	do	Do.
METALS			
Aluminum:			
Harvey Aluminum Co	The Dalles, Oreg. 97058	do	Wasco.
Reynolds Metals Co	Troutdale, Oreg. 97060	do	Multnomah.
Ferroalloys:			
Hanna Nickel Smelting Co	Riddle, Oreg. 97469	do	Douglas.
Union Carbide Corp., Mining & Metals Division.[1]	Portland, Oreg. 97200	do	Multnomah.
National Metallurgical Co	Springfield, Oreg. 97477	do	Lane.
Copper:			
Darrell Carper	Halfway, Oreg. 97834	Mine (lode)	Baker.
Omex Co	Roseburg, Oreg. 97470	do	Coos.
Gold:			
Dark Canyon Properties	Williams, Oreg. 97544	do	Josephine.
Osee E. Oden	Wolf Creek, Oreg. 97497	do	Do.
Mercury:			
Alcona Mining, Inc	Springfield, Oreg. 97477	Mine	Douglas.
Black Butte Mining Co	Cottage Grove, Oreg. 97424	do	Lane.
Canyon Creek Mercury Mine	Canyon City, Oreg. 97820	do	Grant.
Jackson Mountain Mining	Winnemucca, Nev. 89445 (Hampton, Oreg.)	do	Lake.
New Idria Mining & Chemical Co	Idria, Calif. 95027	do	Malheur.
Nickel: Hanna Mining Co	Riddle, Oreg. 97469	do	Douglas.
Steel: Oregon Steel Mills	Portland, Oreg. 97200	Plant	Multnomah.
Titanium: Oregon Metallurgical Corp	Albany, Oreg. 97321	do	Linn.
Zirconium: Wah Chang Albany Corp	Albany, Oreg. 97321	do	Do.

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[1] Produces ferromanganese and silicomanganese.

The Mineral Industry of Pennsylvania

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Pennsylvania Bureau of Topographic and Geologic Survey for collecting information on all minerals except fuels.

By Charles C. Yeloushan [1]

The mineral industry of Pennsylvania reported production in 1968 valued at $904 million, a $5.6 million increase from that of 1967. Portland cement production accounted for an $8.6 million total value increase, but the total value reported for bituminous coal decreased $10.4 million. Stone production continued its strong and steady rise, accounting for a $5.0 million increase in total value. Anthracite production continued its downward trend for the sixth consecutive year with output 800,000 tons less than that of 1967, although its total value increased $1.1 million because of a $0.63 per ton increase in unit price. Copper production increased 21 percent in total value while the total value for the recoverable content of zinc decreased 13 percent. Total values reported for recoverable gold and silver production increased considerably. Other commodities reporting total value increases were masonry cement, clays, sand and gravel, cobalt, iron ore, mica, and pyrites. Commodities with total value decreases were lime, natural gas, natural gas liquids, peat, crude petroleum, and sericite schist. Production of tripoli increased in tonnage but the unit value decreased.

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[1] Mining engineer, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Pennsylvania[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland……thousand 376-pound barrels..	40,197	$114,592	43,018	$123,176
Masonry……thousand 280-pound barrels..	2,929	7,948	3,151	8,706
Clays [2]……thousand short tons..	2,994	16,703	3,084	17,679
Coal:				
Anthracite……do….	12,256	96,160	11,461	97,245
Bituminous……do….	79,412	419,345	76,200	408,982
Copper……short tons..	4,401	3,365	4,850	4,059
Gem stones……	NA	4	NA	4
Lime……thousand short tons..	1,719	24,715	1,702	24,272
Natural gas……million cubic feet..	89,966	25,280	87,987	24,460
Natural gas liquids:				
Natural gasoline and cycle products thousand 42-gallon barrels..	28	77	27	73
LP gases……do….	42	114	37	95
Peat……short tons..	39,505	437	35,806	385
Petroleum (crude)……thousand 42-gallon barrels..	4,387	19,701	4,160	18,698
Sand and gravel……thousand short tons..	17,479	29,614	18,101	31,076
Stone……do….	60,155	103,157	62,812	108,151
Zinc [3] (recoverable content of ores, etc.)……short tons..	35,067	9,468	30,382	8,203
Value of items that cannot be disclosed: Clays (kaolin), cobalt, gold, iron ore, mica, pyrites, sericite-schist, silver, and tripoli……	XX	27,718	XX	28,780
Total……	XX	898,398	XX	904,044
Total 1957–59 constant dollars……	XX	928,234	XX	p 900,383

p Preliminary. NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes kaolin; included with "Value of items that cannot be disclosed."

[3] Recoverable zinc valued at the yearly price of prime western slab zinc, East St. Louis market. Represents value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

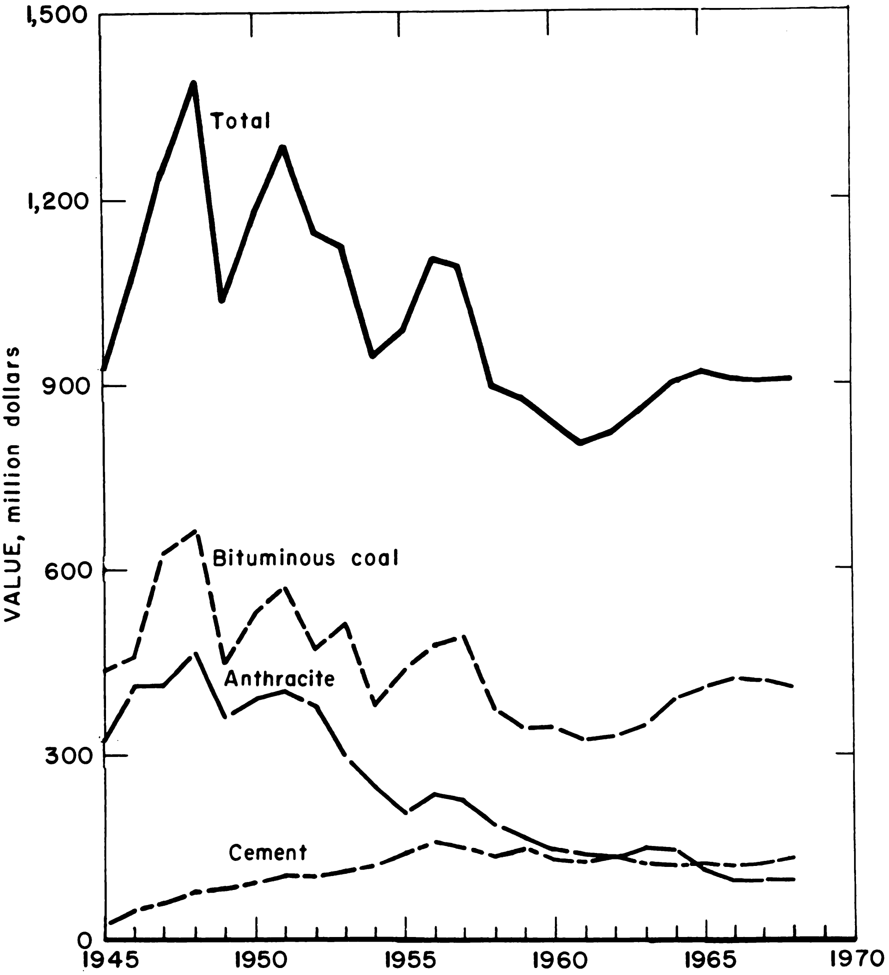

Figure 1.—Value of bituminous coal, anthracite, cement, and total value of mineral production in Pennsylvania.

Table 2.—Value of mineral production in Pennsylvania, by counties[1] [2]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Adams	W	W	Stone, lime, sericite schist, clays.
Allegheny [3]	$27,585	$31,463	Coal, cement, clays, sand and gravel, stone, iron ore (pigment material).
Armstrong	28,875	32,746	Coal, sand and gravel, clays, stone, lime.
Beaver	2,435	3,647	Clays, sand and gravel, coal.
Bedford	W	W	Stone, coal, lime, sand and gravel.
Berks	W	W	Iron ore, cement, stone, clays, cobalt, coal, sand and gravel, pyrites.
Blair	W	W	Stone, clays, coal.
Bradford	W	W	Sand and gravel.
Bucks	W	W	Sand and gravel, stone, clays.
Butler [4]	10,883	11,741	Coal, cement, stone, lime, sand and gravel.
Cambria	W	W	Coal, clays, stone, iron ore (pigment material).
Carbon	5,683	5,714	Coal, stone, sand and gravel.
Centre	18,825	18,117	Lime, stone, coal, sand and gravel, clays.
Chester	4,008	W	Stone, lime, clays.
Clarion	12,878	11,264	Coal, stone, sand and gravel, clays.
Clearfield	29,630	27,605	Coal, clays.
Clinton	4,064	W	Coal, stone, clays.
Columbia	4,009	3,164	Coal, sand and gravel, stone, lime, peat.
Crawford	395	458	Sand and gravel.
Cumberland	W	W	Stone, sand and gravel, clays.
Dauphin	3,099	3,511	Stone, coal, sand and gravel, clays.
Delaware	W	W	Stone.
Elk	W	W	Coal, stone.
Erie	W	W	Sand and gravel, peat.
Fayette	7,083	6,809	Coal, stone, clays.
Forest	W	W	Sand and gravel.
Franklin	1,607	1,658	Stone, sand and gravel.
Fulton	W	W	Do.
Greene	W	80,454	Coal.
Huntingdon	W	W	Sand and gravel, stone, coal, clays.
Indiana	W	W	Coal, clays.
Jefferson	W	W	Coal, clays, stone, sand and gravel.
Lackawanna	W	W	Coal, sand and gravel.
Lancaster	8,023	7,416	Stone, coal, clays, sand and gravel.
Lawrence	W	W	Cement, stone, coal, sand and gravel, clays, peat.
Lebanon	22,017	23,565	Iron ore, copper, stone, lime, cobalt, pyrites, gold, silver.
Lehigh	30,183	30,875	Cement, zinc, stone.
Luzerne	38,990	36,264	Coal, sand and gravel, stone, peat, clays.
Lycoming	W	W	Stone, sand and gravel, coal, tripoli.
McKean	302	284	Clays, stone.
Mercer	1,930	1,405	Sand and gravel, coal, stone, peat.
Mifflin	W	W	Sand and gravel, stone, lime.
Monroe	697	826	Stone, sand and gravel, clays, peat.
Montgomery	W	W	Stone, cement, lime, clays.
Montour	W	W	Stone.
Northampton	59,169	63,071	Cement, stone, sand and gravel.
Northumberland	W	W	Coal, clays, stone.
Perry	W	W	Stone.
Philadelphia	W	W	Sand and gravel.
Potter	125	108	Stone.
Schuylkill	36,017	39,140	Coal, stone, sand and gravel, clays.
Snyder	431	518	Stone, sand and gravel, coal.
Somerset	18,209	18,111	Coal, stone, clays.
Sullivan	184	200	Coal.
Susquehanna	W	W	Stone, coal.
Tioga	3,113	W	Coal, sand and gravel.
Union	W	W	Stone.
Venango	W	W	Coal, sand and gravel, stone.
Warren	930	988	Sand and gravel.
Washington	W	W	Coal, stone, clays.
Wayne	W	800	Sand and gravel, stone, peat.
Westmoreland	W	22,441	Coal, sand and gravel, stone, lime.
Wyoming	W	W	Sand and gravel, stone.
York [4]	9,472	9,891	Cement, stone, lime, clays, sand and gravel, mica.
Undistributed	507,547	409,792	
Total [5]	898,398	904,044	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Cameron, Juaniata, and Pike Counties are not listed because no production was reported.

[2] Values of natural gas, natural gasoline, LP gases, petroleum, and gem stones unspecified by counties; included with "Undistributed."

[3] Excludes cement; included with "Undistributed."

[4] Excludes cement and lime; included with "Undistributed."

[5] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Pennsylvania business activity

	1967	1968	Change (percent)
Employment and labor force, annual average:			
Total labor force, thousands	4,846.3	4,902.4	+1.2
Unemployment, percent of labor force	3.4	3.2	−5.9
Employment:			
Manufacturing, thousands	1,556.9	1,560.3	+.2
Durable goods, do	929.3	925.6	−.4
Lumber and wood products, do	14.9	15.2	+2.0
Furniture and fixtures, do	28.3	29.1	+2.8
Stone, clay, and glass products, do	65.2	63.6	−2.5
Primary metals, do	256.3	253.9	−.9
Fabricated metal products, do	113.4	112.6	−.7
Nonelectrical machinery, do	139.6	139.1	−.4
Electrical machinery, do	159.7	157.7	−1.3
Transportation equipment, do	74.1	74.2	+.1
Instruments, do	38.4	38.3	−.3
Nondurable goods, do	627.6	634.6	+1.1
Food products, do	114.8	114.6	−.2
Apparel and related products, do	179.6	180.4	+.4
Paper products, do	45.3	45.5	+.4
Printing, do	70.6	71.4	+1.1
Chemical products, do	60.5	61.1	+1.0
Nonmanufacturing, do	2,610.3	2,691.3	+3.1
Mining, do	42.0	38.5	−8.3
Contract construction	181.5	192.6	+6.1
Payroll average weekly earnings: Manufacturing	$112.52	$119.20	+5.9
Personal income:			
Total, millions	$37,065	$39,987	+7.9
Per capita	$3,176	[p] $3,409	+7.3
Construction activity:			
New housing units authorized	48,126	46,147	−4.1
Cement shipments to and within Pennsylvania thousand 376-pound barrels	17,527	18,468	+5.4
Mineral production, millions	$898	$904	+.7

[p] Preliminary.

Sources: Pennsylvania Department of Labor and Industry, Bureau of Employment Security; U.S. Department of Labor, Employment and Earnings; U.S. Department of Commerce, Survey of Current Business and Construction Reports.

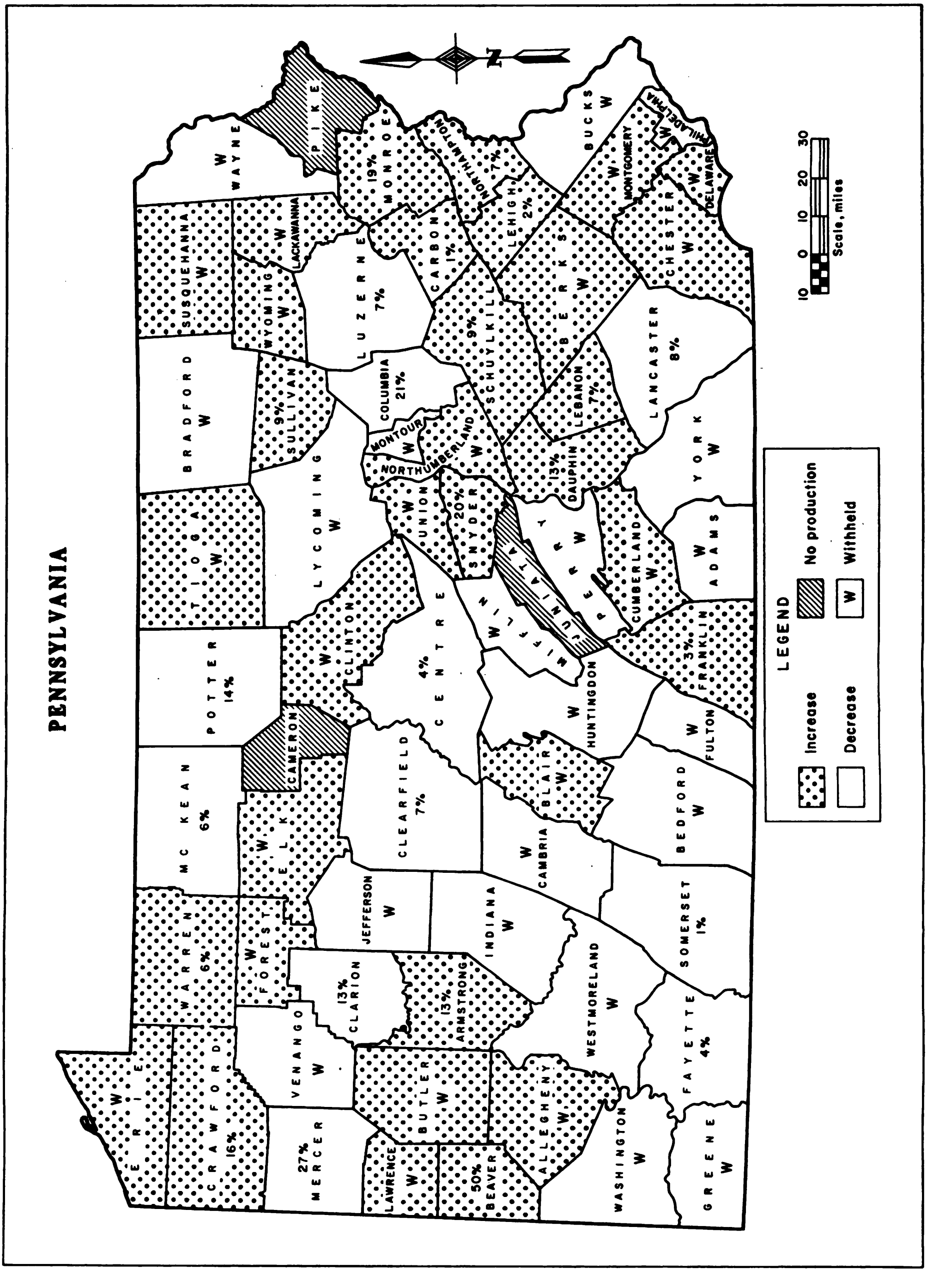

Figure 2.—Change in value of county mineral production from 1967.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Bituminous coal	22,504	234	5,275	42,247	27	942	22.94	5,642
Anthracite	7,750	219	1,701	12,359	9	609	50.00	5,511
Metal	1,602	280	448	3,586	2	31	9.20	3,663
Nonmetal	1,428	250	357	2,920	-------	89	30.48	740
Sand and gravel	1,197	240	287	2,410	1	55	23.24	3,730
Stone	8,351	267	2,227	18,304	9	281	15.84	3,439
Peat	46	224	10	84	-------	4	47.87	3,770
Total [1]	42,878	240	10,306	81,910	48	2,011	25.14	4,810
1968: [p]								
Bituminous coal	21,500	229	4,933	39,740	30	880	22.87	6,821
Anthracite	6,932	217	1,508	11,011	4	504	46.13	4,182
Metal	1,475	299	441	3,538	1	32	9.33	2,124
Nonmetal	1,405	252	354	2,875	1	103	36.18	6,194
Sand and gravel	1,235	239	296	2,488	-------	70	28.14	3,421
Stone	8,305	270	2,246	18,370	3	279	15.35	1,664
Peat	50	230	12	91	-------	1	10.98	44
Total [1]	40,930	239	9,789	78,115	39	1,869	24.41	4,630

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Anthracite).—For the sixth consecutive year anthracite production decreased, falling to a new modern-day low of 11.5 million tons in 1968. Not since 1862 has anthracite production fallen below 12 million tons annually. Anthracite production reached a peak in 1917 with nearly 100 million tons and has steadily decreased since then.

The average value of anthracite was $8.48 per short ton, an increase of $0.63 over that of 1967. Exports to Europe amounted to 880,000 tons which included 820,000 tons consigned to the U.S. military forces in West Germany and the Netherlands.

Of the total production, 10.8 million tons were processed from preparation plants, 606,000 tons from dredges, and 56,000 tons were used at collieries for power and heat; 6.5 million tons was shipped by truck and 4.9 million tons by rail.

Of the 2.5 million tons of anthracite produced from underground mines (22 percent of the total production) 1.5 million tons was mechanically loaded by 131 scraper loaders, 26 mobile loaders, and 184 conveyor and pit-car loaders (including duckbills and other self-loading conveyors). Of the 4.7 million tons of fresh-mined anthracite produced from strip pits (41 percent of the total production), 1.6 million tons came from Lehigh Region, 2.1 million tons from Schuylkill Region, and 1.0 million tons from Wyoming Region. Equipment used to recover coal from culm banks and strip pits included 113 power shovels and 190 draglines. Of the 3.7 million tons of anthracite produced from culm banks (32 percent of the total production), 1.9 million tons came from Schuylkill Region, 960,000 tons from Lehigh Region, and 880,000 tons from Wyoming Region. Of the 606,000 tons of anthracite produced by dredges (5 percent of the total production), 561,000 tons came from Susquehanna River with an average value of $3.68 per ton and 45,000 tons from Schuylkill River with an average value of $3.50 per ton. Anthracite (from all sources) shipped by rail had an average value of $8.06 per ton, $8.84 per ton by truck, and $3.83 per ton for colliery fuel.

The anthracite industry averaged 217 days worked during the year with an average of 6,932 men working daily (818 men less than in 1967). Of the average number of men working daily, 1,683 worked underground, 1,891 in strip pits, 603 at culm banks, 1,773 at preparation plants, 68 on dredges, and 914 at other surface jobs.

Productivity from all operations except dredges averaged 7.31 tons per man-day, while dredges averaged 33.2 tons per man-day for an overall average of 7.62 tons per man-day (0.41 ton better than in 1967).

Schuylkill County replaced Luzerne County as the leading producer with 4.2 million tons, although Luzerne County followed closely with 3.6 million tons. Schuylkill Region produced 6.0 million tons followed by Wyoming Region with 2.9 million tons and Lehigh Region with 2.6 million tons.

Four work deaths were reported for the year (marking the best year in statistical history of fatality experience), five fewer than in 1967. Frequency rate of fatalities dropped to 0.39 per million man-hours of exposure compared with 0.73 for 1967. Nonfatal injuries totaled 504 compared with 609 in 1967 although the frequency rate increased from 49.28 per million man-hours of exposure in 1967 to 45.77 in 1968.

Coal (Bituminous).—Bituminous coal production totaled 76.2 million tons at an average value of $5.37 per ton. The 47.6 million tons sold in the open market averaged $4.40 per ton, and the 28.6 million tons not sold in the open market averaged $6.97 per ton. Of the total output, 57.6 million tons was shipped by rail or water, 15.3 million tons by truck, and the remainder by other means. Unit train shipments totaled 18 million tons.

There were 805 mines, including 261 underground mines producing 54.6 million tons, 489 strip mines producing 20.9 million tons, and 55 auger mines producing 667,000 tons.

Pennsylvania is divided into two bituminous coal-producing districts. District 1 consists of Bedford, Blair, Bradford, Cambria, Cameron, Centre, Clarion, Clearfield, Clinton, Elk, Forest, Fulton, Huntingdon, Jefferson, Lycoming, McKean, Mifflin, Potter, Somerset, and Tioga Counties; that part of Armstrong County including mines served by the P. & S. R.R. on the west bank of the Allegheny River, and north of the Conemaugh division of the Penn Central Railroad; that part of Fayette County including all mines on and east of the line of Indian Creek Valley branch of the Baltimore & Ohio Railroad; that part of Indiana County north of but excluding the Saltsburg branch of the Penn Central Railroad between Edri and Blairsville, both exclusive; and that part of Westmoreland County including all mines served by the Penn Central Railroad, Torrance, and east.

Table 5.—Coal (bituminous) production, by counties

County	Number of mines				Production (thousand tons)	Average price per ton
	Underground	Strip	Auger	Total		
Allegheny	11	11	--------	22	5,148	$5.84
Armstrong	25	36	7	68	6,653	4.32
Bedford	3	2	--------	5	86	3.73
Blair	1	--------	--------	1	3	6.45
Butler	9	30	7	46	1,946	4.08
Cambria	46	18	2	66	7,776	5.96
Centre	1	14	--------	15	706	4.19
Clarion	1	67	3	71	2,890	3.59
Clearfield	18	58	7	83	6,160	3.93
Clinton	--------	11	--------	11	794	3.83
Elk	5	11	5	21	359	3.94
Fayette	6	22	--------	28	509	5.42
Greene	18	3	--------	21	11,688	6.88
Indiana	41	24	12	77	6,648	4.82
Jefferson	13	37	11	61	1,576	3.95
Lawrence	--------	22	--------	22	1,012	3.49
Lycoming	--------	3	--------	3	60	4.25
Mercer	--------	5	--------	5	184	3.44
Somerset	35	60	--------	95	4,111	4.00
Venango	--------	13	--------	13	445	3.41
Washington	14	16	1	31	13,590	6.57
Westmoreland	12	20	--------	32	2,948	5.69
Other counties [1]	2	6	--------	8	910	3.96
Total	261	489	55	805	[2] 76,200	5.37

[1] Includes data for Beaver, Huntingdon, and Tioga Counties.
[2] Data may not add to total shown because of independent rounding.

District 2 consists of Allegheny, Beaver, Butler, Greene, Lawrence, Mercer, Venango, and Washington Counties; that part of Armstrong County west of the Allegheny River and exclusive of mines served by the P. & S. R.R.; that part of Indiana County including all mines served on the Saltsburg branch of the Penn Central Railroad north of Conemaugh River; Fayette County, except all mines on and east of the line of Indian Creek Valley branch of the Baltimore & Ohio Railroad; and that part of Westmoreland County, including all mines except those served by the Penn Central Railroad from Torrance, east.

District 1 had 184 underground mines accounting for 20.3 million tons, of which 17.5 million tons was sold in the open market for $4.72 per ton; 168 cutting machines cut 2.6 million tons; 131 mines loaded 20.0 million tons mechanically with 219 continuous miners, 74 mobile loaders (22 of which were used with continuous miners), and 50 hand-loaded face conveyors. District 2 had 77 underground mines accounting for 34.3 million tons of which 8.6 million tons was sold in the open market for $5.15 per ton; 94 machines cut 7.0 million tons and 63 mines loaded 34.2 million tons mechanically with 210 continuous miners, 148 mobile loaders (70 of which were used with continuous miners), and three hand-loaded face conveyors.

Strip mines in district 1 totaled 335 and accounted for 16.0 million tons, almost all of which was sold in the open market for $3.82 per ton. Stripping was accomplished by 423 shovels, 241 draglines (eight of which had over 12 cubic yards of capacity), 18 carryall scrapers (five of which had over 12 cubic yards of capacity), 483 bulldozers, 139 drills and 805 trucks. The 154 strip mines in district 2 recovered 4.9 million tons of coal, almost all of which was sold in the open market for $3.85 per ton. Stripping was accomplished with 167 shovels (one of which had the capacity of over 12 cubic yards), 97 draglines (two of which had over 12 cubic yards capacity), 11 carryall scrapers (five of which had over 12 cubic yards of capacity), 178 bulldozers, 55 power drills, and 345 trucks.

The 46 auger mines in district 1 produced 501,000 tons at an average of $4.10 per ton with 39 augers, five bulldozers, two power drills, and 38 trucks. A total of nine auger mines in district 2 produced 166,000 tons at $3.92 per ton with 10 augers, one bulldozer, two power drills, and four trucks.

Eighty-five preparation plants mechanically cleaned 48.5 million tons of coal, of which 41.9 million tons came from underground mines, 6.5 million tons from strip mines, and 124,000 tons from auger mines; 30.5 million tons was cleaned by wet-washing other than jigs, 11.4 million tons by jigs, and 6.6 million tons by pneumatic methods. Coal was crushed at 165 plants for a total of 37.2 million tons with 48 plants treating 10.8 million tons with calcium chloride, oil, or other materials. Thermal drying was conducted at 11 plants with a total of 16 thermal units drying 5.7 million tons.

During the year 30 fatal and 880 nonfatal lost-time injuries occurred. Of the fatalities, 26 occured underground (13 from falls of roof, six on haulage, four on machinery, two from electricity, and one from falls of face, side, rib, or pillar), one on machinery in strip mines, and two in mechanical cleaning plants (one on haulage and one on machinery).

In the 1968 National Safety Competition, Certificates of Achievement in Safety for outstanding safety records in the Underground-Coal Group were awarded to the Robena No. 3 mine for 573,288 man-hours worked without a disabling work injury, Robena No. 2 mine for 541,951 man-hours, and Karen mine for 215,812 man-hours, all owned and operated by United States Steel Corp. Kinseley No. 10 mine, Kinseley Coal Co., was also awarded a Certificate of Achievement in Safety in the Underground-Coal Group for 44,475 man-hours worked without a disabling work injury. Certificates of Achievement in Safety in the Surface-Coal Group were awarded to Sligo strip mine, Allison Engineering Co., for 96,450 man-hours worked without a disabling work injury; Decker strip mine, Decker Construction Co., for 52,230 man-hours; Simca Mining No. 1 strip mine, Simca Mining, Inc., for 43,658 man-hours; and Miller & McKnight strip mine, Miller & McKnight Coal Co., for 35,963 man-hours.

Natural Gas Liquids.—Production of natural gas liquids totaled 64,000 (42-gallon) barrels, a decrease of 8.6 percent from that of 1967. Of the total, 37,000 barrels was liquefied petroleum (LP) gases and ethane from natural gas processing plants, and 27,000 barrels was natural gasoline and cycle products. Natural gasoline and cycle products averaged $2.70 per barrel ($2.75 in 1967) and LP gases and ethane averaged $2.56 per barrel ($2.71 in 1967). Gas-processing plants included Mars Co.'s Lamont plant in the Kane field, Elk County, and Van plant in the Strong field, Venango County; Pennsylvania Gas Co.'s Roystone Station in Warren County; and Peoples Natural Gas Co.'s Greene Station in Greene County. According to The Oil and Gas Journal, proved reserves of gas liquids at yearend totaled 1.1 million barrels.

Peat.—Nine operations in seven counties reported a total peat production of 38,400 tons, a 7.6 percent decrease in tonnage from that of 1967. Sales totaled 35,800 tons (a 9.4-percent decrease from that of 1967) at an average price of $10.74 per ton ($0.32 per ton less than in 1967). Of the total sold, 55 percent was reported as humus, 42 percent as reed sedge and 3 percent as moss; 76 percent was sold in bulk for general soil improvement at $10.23 per ton. Of the total peat produced, 90 percent of the tonnage was shredded for preparation prior to marketing, 10 percent was unprepared, and none was kiln-dried. Luzrene County continued to be the leading producer with 37.5 percent of the total production; other counties producing peat were Columbia, Erie, Lawrence, Mercer, Monroe, and Wayne.

Petroleum and Natural Gas.—Crude petroleum production decreased 5 percent from that of 1967. Production of Penn grade crude petroleum totaled 4.1 million (42-gallon) barrels valued at $18.5 million, in addition to 59,000 barrels of Corning grade crude petroleum produced in Crawford and Erie Counties from the Medina (Lower Silurian) Sandstone, valued at $170,000. The number of producing oil wells at yearend was 42,500, a 500-well increase from that of yearend 1967. Estimated proved recoverable reserves of crude oil at yearend totaled 59.2 million barrels. Operating capacity of 13 crude oil refineries at yearend totaled 629,000 barrels per calendar day.

Production of natural gas totaled 88 billion cubic feet (Bcf), a 2-percent decrease from that of 1967. Production from shallow (Upper Devonian or younger) reservoirs totaled 62 Bcf, while production from deep (Oriskany or older) reservoirs totaled 26 Bcf. The estimated number of producing gas wells at yearend was 17,000. Estimated proved reserves of natural gas, including 487 Bcf in underground storage at yearend, totaled 1,345 Bcf, a decrease of 47 Bcf from that of yearend 1967.

According to the Oil and Gas Division, Pennsylvania Bureau of Topographic and Geologic Survey, 922 wells were drilled during 1968, including 471 oil wells, 254 gas wells, 101 service wells, 25 miscellaneous wells, one stratigraphic test, and 70 dry holes. Of the 26 old wells drilled deeper, 21 were gas wells, one was an oil well, and four were dry. The total footage of all wells drilled was 1,834,131, of which 1,373,480 was development footage, 167,490 was exploratory footage, and 293,161 feet were in service wells, stratigraphic, and miscellaneous drilling. Of 795 well completions, 61 were exploratory (38 percent successful) and 734 were development (96 percent successful).

Warren County continued to be the most active oil area, with 238 new successful wells completed in 1968. Indiana County was the most active gas area, with 101 succesful wells completed. Seismic crews logged 23 crew-weeks during the year compared with 17 crew-weeks in 1967. All of the Commonwealth's acreage under Lake Erie, which comprises 369,989 acres, was offered to the oil and gas industry for lease through competitive bidding. Of the 37 blocks offered, four blocks comprising 24,509 acres were leased for oil and gas exploration. The highest bonus bid for this acreage was $6 per acre, which carries a yearly rental of $1 per acre. In addition, 15,897 acres of onshore State forest lands were leased through competitive bidding for $4.62 per acre plus a yearly rental of $1 per acre. At yearend, a total of 151,191 acres, including 59,109 acres in gas storage, of State forest lands were under lease for oil and gas exploration and development.

Project Ketch was cancelled at midyear. This was an experiment proposed by the Atomic Energy Commission and Columbia Gas Corporation to determine whether it is economically and technically feasible to create a natural gas storage reservoir by detonating an atomic device beneath Sproul State Forest in Clinton County.

NONMETALS

Cement.—Portland cement shipments increased 7 percent above those of 1967 with the average value per 376-pound barrel increasing $0.01 to $2.86. Shipments of masonry cement increased 8 percent over those of 1967 with the average value per 280-pound barrel increasing $0.05 to $2.76. Finished portland cement was produced at 22 plants during 1968 which had a total annual production capacity of 51.2 million barrels, an increase of 300,000 barrels from that of 1967. Masonry cement was shipped from 21 plants during 1968.

The dividing line between eastern and western Pennsylvania is along the eastern boundaries of Potter, Clinton, Centre, Huntingdon, and Franklin Counties. Portland cement shipments of all types from the five plants in western Pennsylvania totaled 11.7 million barrels at an average price of $3.12 per barrel, of which 92 percent was types I–II (general use and moderate heat), 3 percent was type III (high-early-strength), and 1 percent was portland-pozzolan; 51 percent was shipped to locations in western Pennsylvania, 35 percent to Ohio, and 7 percent to West Virginia. Of the total shipments from western Pennsylvania, 10.0 million barrels were shipped by truck in bulk, 1.2 million barrels by truck in containers, 490,000 barrels by railroad in bulk, and 31,000 barrels by railroad in containers.

Portland cement shipments of all types from 17 plants in eastern Pennsylvania totaled 31.3 million barrels at an average price of $2.77 per barrel, of which 90 percent was types I–II, 6 percent type III, and 3 percent white cement; 34 percent was shipped to locations in eastern Pennsylvania, 27 percent to New Jersey, 15 percent to New York, 7 percent to Connecticut, and 6 percent to Maryland. Of the total shipments from eastern Pennsylvania, 17.2 million barrels was by truck in bulk, 9.2 million barrels by railroad in bulk, 3.7 million barrels by truck in containers, and remainder by railroad.

Of the 11.8 million barrels of portland cement produced in western Pennsylvania, 4.2 million barrels were air-entrained; of 32.1 million barrels produced in eastern Pennsylvania, 5.5 million barrels were air-entrained. Portland cement stocks at yearend totaled 1.8 million barrels in western Pennsylvania and 3.7 million barrels in eastern Pennsylvania.

Ready-mixed concrete companies purchased 18.4 million barrels of portland cement shipped from eastern Pennsylvania and 7.3 million barrels from western Pennsylvania; concrete product manufacturers purchased 7.1 million barrels from the east and 1.5 million barrels from the west, building material dealers purchased 3.4 million barrels from the east and 840,000 barrels from the west, and highway contractors purchased 1.8 million barrels from the east and 1.3 million barrels from the west.

Limestone and cement rock were the chief raw materials used for the manufacture of portland cement, 9.7 million tons in eastern Pennsylvania and 3.1 million tons in western Pennsylvania. Other raw materials used included shale, clay, sand, slag, gypsum, iron ore, and mill scale. Eastern Pennsylvania cement plants purchased 768 million kilowatt-hours of electricity and western plants 303 million kilowatt-hours.

Prepared masonry cement shipped from 16 plants in eastern Pennsylvania totaled 2.0 million barrels at an average price of $2.65 per barrel, of which 21 percent was shipped to locations in eastern Pennsylvania, 29 percent to New Jersey, 17 percent to New York, 8 percent to Virginia, 7 percent to Maryland, 4 percent to Connecticut, and 4 percent to the District of Columbia. Shipments of prepared masonry cement from western Pennsylvania totaled 1.1 million barrels at $2.97 per barrel, of which 51 percent was shipped to locations in western Pennsylvania, 38 percent to Ohio, 3 percent to West Virginia, 4 percent to New York, and 3 percent to Michigan.

The leading portland cement producing county was Northampton, followed by Lehigh County. Other counties producing cement were Allegheny, Butler, and Lawrence in the west, and Berks, Montgomery and York in the east. Northampton County was also the leading masonry cement producer with 25 percent of the total State production.

Clays.—Total production of clays (excluding kaolin) increased 1 percent in tonnage and 6 percent in value from that of 1967. Fire clay accounted for 47 percent of the total production, decreasing 1 percent in tonnage and increasing 3 percent in value. Miscellaneous clays and shale accounted for the remaining 53 percent of the total, increasing 3 percent in tonnage and 11 percent in value.

Gem Stones.—Hobbyists and amateur lapidarists collected mineral specimens at scattered locations throughout the State. The State Bureau of Topographic and Geologic Survey published a guide to collecting localities.[3]

Gypsum.—A gypsum-calcining plant using both domestic and imported crude gypsum was operated at Philadelphia.

Iron-Oxide Pigments.—Red iron-oxide pigments were recovered during plant processing of bauxite to alumina in Allegheny County. Yellow iron-oxide pigments in the form of sulfur mud were mined from an open pit in Cambria County. Finished natural iron-oxide pigments were shipped from a plant in Carbon County. Finished natural and manufactured iron-oxide pig-

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[3] Laphan David M., and Alan R. Geyer. Mineral Collecting in Pennsylvania. Pennsylvania Bureau of Topographic and Geologic Survey, General Geol. Rept. G 33, (3rd. ed., revised 1969).

Table 6.—Clays sold or used by producers, by kinds and uses [1]

(Thousand short tons)

Use	Fire clay		Miscellaneous clay	
	1967	1968	1967	1968
Refractories:				
Firebrick and block	624	681	-------	-------
High alumina brick	74	15	-------	-------
Other	[2] 164	[2] 91	W	W
Heavy clay products:				
Building brick	488	585	1,222	1,228
Vitrified sewer pipe	64	45	63	67
Undistributed	[3] 21	[3] 7	[4] 274	[4] 319
Total	1,435	1,424	1,559	[5] 1,610

W Withheld to avoid disclosing individual company confidential data.

[1] Excludes kaolin.

[2] Includes mortar, clay crucibles, foundries and steel works (bulk), and other refractories.

[3] Includes other heavy clay products, exports (1967), pottery, floor and wall tile, filler (1967), and portland and other hydraulic cements (1968).

[4] Includes other heavy clay products, exports (1968), pottery, floor and wall tile, lightweight aggregate, filler, foundries and steelworks (bulk), and portland and other hydrulic cements.

[5] Data may not add to total shown because of independent rounding.

ments were shipped from two plants in Northampton County.

Lime.—Production of lime (quicklime and hydrated lime) decreased 1 percent in tonnage and 2 percent in total value. Quicklime production decreased from 1.46 million tons in 1967 to 1.42 million tons, while hydrated lime increased from 264,000 tons in 1967 to 284,000 tons. The average price per ton of quicklime decreased from $14.00 to $13.90 while that of hydrated lime decreased from $16.44 to $16.02 per ton. Regenerated quicklime and hydrated lime production totaled 45,800 tons and was valued at $17.52 per ton. Of the total quicklime sold and used, 85 percent was consumed by the chemical and other industrial markets, with the remainder distributed among construction, agricultural, and refractory markets. Of the total hydrated lime sold and used, 45 percent was consumed by the chemical and other industrial markets with the remainder being distributed among agricultural and construction markets. Fourteen plants were operated in 12 counties. Of the 14 producing plants, three plants sold only hydrated lime, three plants sold only quicklime, one plant used only quicklime, one plant sold and used quicklime and hydrated lime, and six plants sold both quicklime and hydrated lime. In addition, regenerated quicklime was used at two pulp and paper mills in Blair County and one in Clinton County; regenerated quicklime and hydrated lime were used at one plant in York County.

Centre County continued to be the leading producer, with three large plants each producing quicklime and hydrated lime and accounting for 47 percent of the total quicklime sold and used, 25 percent of the hydrated lime sold and used, and 38 percent of the total lime value. Of the total lime sold and used, 55 percent was consumed in Pennsylvania, 16 percent in Maryland, 8 percent in Ohio, 6 percent in New Jersey, and 5 percent in New York.

Mica.—Residual mica was produced and processed near Glenville in York County. The processed mica was used in paint, welding rods, rubber, textile coating, grease, electric insulation, and roofing.

Perlite (Expanded).—Crude perlite from out-of-State sources was expanded at one plant each in Allegheny, Delaware, Lehigh, Montgomery, Philadelphia, and York Counties. The name of Refractory & Insulation Corp. in Montgomery County has been changed to C–E Refractories, Division of Combustion Engineering, Inc. Expanded perlite was sold or used chiefly for building plaster, with other uses being loose fill insulation, concrete aggregate, soil conditioning, filler, filter, cryogenic applications, charbase, refractory, foundry, and material for castable insulation and bonding motors.

Pyrites.—Pyrites was recovered in the form of flotation concentrate during the milling of magnetite in Berks and Lebanon Counties and shipped to Sparrows Point, Md., for further processing.

Sand and Gravel.—Production of sand and gravel increased 4 percent in total tonnage and 5 percent in total value. Commercial sand production totaled 10.4 million tons, of which 86 percent was used for building, paving, and fill, selling for an average value of $1.54 per ton, and the remainder was used for other construction purposes, and for industrial unground sand (for glass, molding, grinding and polishing, blast, fire or furnace, engine, filtration, and other uses) and industrial ground sand (for abrasives, chemical, filler, foundry uses, glass, pottery, porcelain, tile, and other uses). Commercial gravel production totaled 7.6 million tons selling for an average value of $1.55 per ton of which 47 percent was used for building construction purposes, 44 percent for paving construction, and the remainder for fill, railroad ballast, and miscellaneous uses. Of the total commercial sand and gravel production, 75 percent was shipped by truck and the remainder by waterway and railroad. Commercial sand and gravel plants included 92 stationary, eight portable, and six dredges.

Bucks County continued to be the leading producing county with 17 percent of the total commercial tonnage and value.

Stone.—Production from all types of stone increased 4 percent in total tonnage and 5 percent in total value. Of the total stone production, 62.7 million tons was crushed or broken. Of the total crushed or broken stone, 51.5 million tons was limestone, 4.1 million tons basalt (trap rock), 3.0 million tons sandstone, 1.8 million tons miscellaneous stone, and the remainder granite, dolomite, shell, slate, and quartz-

Table 7.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Molding	157	$461	142	$421
Building	4,855	7,424	5,420	8,296
Paving	3,678	5,636	3,433	5,343
Fire or furnace	71	223	50	171
Fill	24	20	23	38
Undistributed [1]	1,292	4,336	1,313	4,725
Total	10,077	18,100	10,386	18,994
Gravel:				
Building	2,562	4,141	3,599	5,921
Paving	4,147	6,639	3,367	5,324
Fill	343	214	373	214
Undistributed [2]	298	441	286	386
Total	7,350	11,435	7,625	11,845
Total sand and gravel	17,427	29,535	18,011	30,839
Government-and-contractor operations:				
Sand: Other	52	79	67	171
Gravel:				
Paving	--------	--------	3	7
Other	--------	--------	20	59
Total	--------	--------	23	66
Total sand and gravel	52	79	90	237
All operations:				
Sand	10,129	18,179	10,453	19,165
Gravel	7,350	11,435	7,648	11,911
Total	17,479	29,614	18,101	31,076

[1] Includes glass, grinding and polishing, blast, engine, filtration (1968), ground, and other sand.
[2] Includes railroad ballast, miscellaneous, and other gravel.

ite; 60 percent was used as aggregates, 18 percent for cement manufacture, 8 percent for furnace flux, 5 percent for lime manufacture, 2 percent for agricultural purposes, and the remainder for railroad ballast, riprap, refractory, and other uses.

Dimension stone production decreased 2 percent in tonnage but increased 1 percent in total value from that of 1967. Slate accounted for 36 percent of the total dimension stone tonnage and 67 percent of its value, while sandstone and quartzite accounted for 44 percent of the total tonnage but less than 22 percent of the total value.

The "Sentinels of Safety" trophy winner in the 1968 National Safety Competition in the Quarry Group was the Millard Quarry, Bethlehem Mines Corp., Annville, Lebanon County, Pa., for working 441,522 injury-free man-hours. The Millard Quarry also won the trophy in 1967, its first year in the competition. Other operations competing in the Quarry Group received Certificates of Achievement for their outstanding safety record, including Bethlehem Quarry, Bethlehem Mines Corp., Bethlehem, Pa., for 78,571 man-hours worked without a disabling work injury; Valley Forge Quarry, Martin Marietta Corp., Appalachian Stone Division, Malvern, Pa., for 77,573 man-hours worked; Wampum Quarry, Medusa Portland Cement Co., Wampum, Pa., for 59,410 man-hours worked; Reliance "B" Quarry, Giant Portland Cement Co., Egypt, Pa., for 54,625 man-hours worked; and Llanerch Quarry, V. Di Francesco & Sons Co., Havertown, Pa., for 54,514 man-hours worked without a disabling work injury.

Sulfur.—Sulfur was recovered at four refineries, two in Delaware County and two in Philadelphia County. Of the refineries in Philadelphia County, one recovered sul-

Table 8.—Stone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967		1968	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone	86	$1,417	75	$1,861
Curbing and flagging	34	1,158	34	1,091
Other uses [1]	31	3,838	40	4,009
Total [2]	152	6,414	148	6,460
Crushed and broken stone:				
Riprap	248	356	160	203
Aggregates [3]	36,883	52,585	37,649	55,506
Furnace flux (limestone)	5,790	11,392	5,316	10,828
Railroad ballast	743	1,170	702	1,067
Agricultural	1,110	3,414	1,490	4,080
Other uses [4]	15,230	27,827	17,347	30,005
Total [2]	60,004	96,744	62,664	101,690
Grand total [2]	60,155	103,157	62,812	108,151

[1] Includes monumental, surface plates, refractory blocks, roofing slate and millstock.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes dense graded road base stone and concrete, bituminous, macadam, and surface treatment aggregates.
[4] Includes cement and lime manufacture, refractory, fillers, chemical, and other uses.

Table 9.—Stone sold or used by producers, by counties

(Thousand short tons and thousand dollars)

Counties	1967		1968	
	Quantity	Value	Quantity	Value
Allegheny, Clarion, Washington	623	$1,267	435	$860
Armstrong	443	926	412	886
Bedford, Franklin, Fulton	1,882	3,015	1,871	2,860
Berks	3,594	4,756	4,173	5,169
Blair	1,523	1,840	1,700	2,078
Bucks	3,229	4,398	3,432	5,026
Butler	1,618	2,965	2,082	3,707
Carbon, Monroe, Schuylkill	842	2,059	886	2,188
Centre	3,955	5,911	3,483	5,564
Chester	2,057	3,887	2,540	4,544
Clinton, Lycoming, Montour, Union	1,735	2,396	2,127	2,984
Cumberland	1,036	1,659	1,370	2,211
Dauphin	1,001	1,617	W	W
Elk, McKean, Potter	58	227	59	215
Fayette, Somerset	1,422	3,131	1,478	3,271
Lancaster	3,644	5,205	3,338	4,606
Lawrence, Mercer	2,153	3,336	2,252	3,639
Lebanon	1,727	3,069	2,142	3,677
Lehigh	2,377	2,644	W	W
Luzerne	619	862	W	W
Mifflin, Snyder	621	810	664	896
Montgomery	5,374	8,908	5,330	9,119
Northampton	5,737	9,443	W	W
Northumberland	70	113	87	248
Susquehanna, Wayne, Wyoming	361	1,180	416	1,268
Venango	---------	---------	5	22
Westmoreland	1,440	2,825	W	W
York	3,772	8,281	3,945	8,732
Other counties [1]	7,242	16,426	18,591	34,379
Total [2]	60,155	103,157	62,812	108,151

W Withheld to avoid disclosing individual company confidential data.
[1] Includes Adams, Cambria, Columbia, Delaware, Huntingdon, Jefferson, and Perry Counties and data indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

fur by the Claus process, and the other recovered hydrogen sulfide by the Girdler system, using diethanolamine and monethanolamine, and molten sulfur by the improved Claus-type process. In Delaware County, one refinery recovered sulfur by using single-stage catalytic oxidation of hydrogen sulfide, and the other by using the Claus-type process.

Talc (Sericite-Schist).—Sericite-schist was produced from an open pit and processed near Aspers, Adams County, for use as an asphalt filler, and for use in insecticides, joint cement, and enamel coatings.

Tripoli (Rottenstone).—Tripoli was produced by two operations in Lycoming County. One operation near Oriole processed the material by drying, crushing, and grinding in Raymond Roller Mills and used it as an abrasive and as a filler. The other operation near Muncy prepared the material for use as a filler.

Vermiculite (Exfoliated).—Crude vermiculite was exfoliated at two operations. One operation (in Lawrence County) produced the exfoliated product for use as loose-fill insulation, building plaster aggregate, fire base, concrete aggregate, and for agricultural purposes. The other operation (in Bucks County) prepared the material for home insulation, packing, concrete and plaster aggregate, and horticultural purposes.

METALS

Cadmium.—Cadmium was recovered as a byproduct in the smelting of zinc concentrate at the Josephtown plant in Beaver County and at the Palmerton plant in Carbon County. Cadmium production increased considerably from that of 1967.

Cobalt.—Cobalt was recovered as a byproduct of pyrite concentrate produced from the mining and flotation of magnetite in Berks and Lebanon Counties. The cobalt content of pyrite concentrate shipments increased slightly from that of 1967.

Copper, Gold, and Silver.—Copper concentrate (recovered by flotation of magnetite iron ore mined in Lebanon County and shipped to western refineries for processing) increased 10 percent in tonnage and 21 percent in value. The concentrate contained gold and silver both of which increased considerably in tonnage and value from that of 1967.

Iron Ore.—Usable iron ore production and shipments increased 4 percent in tonnage and value. Shipments were in the form of pellets produced at agglomerating plants located at magnetite mines in Berks and Lebanon Counties. Most of the iron ore pellets were shipped to company-owned iron and steel plants in the State and in Maryland.

Iron and Steel.—Production of pig iron totaled 21.0 million tons, of which 93 percent was basic pig iron, and the remainder Bessemer, malleable, and direct castings.

Consumption of iron ore totaled 20.4 million tons, of which 56 percent was used in blast furnaces, 40 percent in agglomerating plants, and the remainder in the steel furnaces. Receipts of iron ore during the year totaled 23.5 million tons of which 64 percent came from foreign countries and 36 percent from domestic sources. Iron ore stocks at the beginning of the year were 12.3 million tons, and 11.0 million tons at yearend, with 4.3 million tons sold and shipped to other plants during the year. Fluxes consumed by the iron and steel industry included 2.8 million tons of limestone, 3.4 million tons of dolomite, and 480,000 tons of other type fluxes. Other materials consumed included 1.5 million tons of mill cinder and roll scale, 746,000 tons of raw flue dust, 1.2 million tons of steel furnace slag, 13 million tons of coke, and 750,000 tons of coke breeze. Steel furnaces consumed 19.7 million tons of pig iron and hot metal, and 11.1 million tons of home and purchased scrap. Blast furnaces consumed 755,000 tons of home and purchased scrap and 272,000 tons of slag scrap. Agglomerates consumed in blast furnaces included 8.2 million tons of U.S. sinter (regular), 5.3 million tons of iron ore pellets (regular), and 2.5 million tons of foreign iron ore and other agglomerates. Scrap produced at blast furnaces totaled 176,000 tons, slag produced 6.2 million tons, and flue dust recovered 662,000 tons.

Forty-five blast furnaces were active during the year (one less than in 1967) at 20 plants operated by nine companies. Fifteen blast furnaces were idle during the year.

Steel production, according to the American Iron and Steel Institute, totaled 31.0 million tons, of which 19.7 million tons were from open hearth and Bessemer, 8.0 million tons from basic oxygen process, and 3.3 million tons from electric furnaces. Production of hot-rolled steel products totaled 22.6 million tons; hot-rolled bars and light structural shapes, 2.6 million tons; concrete reinforcing bars, 930,000 tons; wire rods, 660,000 tons; and 1.9 million tons of blanks, tube rounds or pierced billets for seamless tubing.

Zinc.—Production of zinc ore (based on the quantity of recoverable zinc metal) decreased 13 percent in tonnage and value. The ore was mined and processed in Lehigh County, and the concentrate shipped to a smelter in Carbon County.

Smelters located at Palmerton in Carbon County and at Josephtown in Beaver County received zinc concentrate from company-owned mines and concentrating plants and from other domestic and foreign sources. Products from the Palmerton smelter included rolled zinc, slab zinc, zinc base die casting alloys, dry-battery shells, zinc oxide, spiegeleisen, and cadmium. Products from the Josephtown smelter included zinc and cadmium metal, lead-free zinc oxide, and sulfuric acid.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Nonmetallic: Satellite Alloy Corp.	9800 McKnight Rd. Pittsburgh, Pa. 15237	Plant	Allegheny.
Metallic:			
Abrasive Metals Co	26th & B. & O. RR Pittsburgh, Pa. 15222	do	Do.
Durasteel Abrasive Co	2601 Smallman St. Pittsburgh, Pa. 15222	do	Westmoreland.
Industeel Corp	37th & A. V. RR Pittsburgh, Pa. 15222	do	Allegheny.
The Pangborn Corp., Rotoblast Abrasive Division.	P.O. Box 280 Hagerstown, Md. 21740	do	Butler.
Cement:			
Allentown Portland Cement Co.[1]	7th St. at Thruway Allentown, Pa. 18101	do	Berks and Montgomery.
Bessemer Cement Co., Subsidiary of Louisville Cement C[illegible]	510 Hanna Bldg. Cleveland, Ohio 44115	do	Lawrence.
Coplay Cement Mfg. Co.[1]	[illegible] North 2d St. [illegible] Pa. 18037	do	Lehigh.
Do	[illegible]	do	Northampton.
Dragon Cement Co., Div. of Martin Marietta Corp.[1]	[illegible]e. N[illegible] 08903	do	Do.
Giant Portland Cement Co.[1]	1500 [illegible] Philadelphia[illegible]102	do	Lehigh.
Green Bag Cement Co., Div. of Marquette Cement Mfg. Co.	20 N. Wacker [illegible] Chicago, Ill. 60606	do	Allegheny.
Hercules Cement Co., Div. of American Cement Corp.[1]	555 City Line Ave. Bala-Cynwyd, Pa. 19004	do	Northampton.
Keystone Portland Cement Co.[1]	1400 So. Penn Square Philadelphia, Pa. 19102	do	Do.
Lehigh Portland Cement Co.[1]	718 Hamilton St. Allentown, Pa. 18105	do	Lehigh.
Lone Star Cement Corp.[1]	P.O. Box 6237 West End Br. Richmond, Va. 23230	do	Northampton.
Medusa Portland Cement Co.[2]	P.O. Box 5668 Cleveland, Ohio 44101	do	Lawrence.
Do.[3], [4]		do	York.
National Portland Cement Co.[1]	1023 W. St. George Ave. Linden, N.J. 07036	do	Northampton.
Penn-Dixie Cement Corp.[5]	P.O. Box 152 Nazareth, Pa. 18064	do	Butler.
Do.[1]		do	Northampton.
Universal Atlas Cement Div. U.S. Steel Corp.	Chatham Center Pittsburgh, Pa. 15230	do	Allegheny.
Do.[1]		do	Northampton.
The Whitehall Cement Mfg. Co.[1]	123 S. Broad St. Philadelphia, Pa. 19109	do	Lehigh.
Clay and shale:			
Fire:			
Drexel Refractories	P.O. Box 50 Kittanning, Pa. 16201	Underground	Armstrong.
Eastvale-Standard Clay Products Co.[4]	Box 681 Beaver Falls, Pa. 15010	do	Beaver.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clay and shale—Continued			
Fire—Continued			
Freeport Brick Co	Drawer F. Freeport, Pa. 16229	Underground	Armstrong.
Freeport Brick Co., Kittanning Brick Div.	R.D. 1 Adrian, Pa. 16210	do	Do.
Hanley Co.[6]	28 Kennedy St. Bradford, Pa. 16701	do	Jefferson.
Harbison-Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15222	do	Armstrong and Clearfield.
Do		Pit	Centre, Clearfield, Fayette.
The Negley Fire Clay Co	Box 264 New Galilee, Pa. 16141	Pit	Lawrence.
Ralph A. Veon, Inc	Darlington, Pa. 16115	Pit	Do.
Kaolin: The Philadelphia Clay Co.	236 W. North St. Carlisle, Pa. 17013	Pit	Cumberland.
Miscellaneous:			
Alwine Brick Co	New Oxford, Pa. 17350	Pit	Adams.
Bylite Corp	P.O. Box 1628 N. Station Wilkes Barre, Pa. 18700	Pit	Luzerne.
Fenati Brick Co., Inc	New Castle, Pa. 16101	Pit	Lawrence.
Glen-Gery Corp	227 N. 5th St. Reading, Pa. 19600	Pit	Berks, Dauphin, Lancaster, Northumberland, York.
Mc Avoy Vitrified Brick Co.	Phoenixville, Pa. 19460	Pit	Chester.
McQuiston Coal Co	109 East Moody New Castle, Pa. 16101	Pit	Lawrence.
Milliken Brick Co., Inc.[4]	2100 Montier St. Pittsburgh, Pa. 15221	Pit	Allegheny.
The Robinson Clay Product Co	65 W. State St. Akron, Ohio 44309	Pit	Montgomery.
Coal:			
Anthracite:			
Blue Coal Corp	101 S. Main St. Ashley, Pa. 18706	Underground	Luzerne.
Do.[7]		Culm bank	Lackawanna and Luzerne.
Blue Coal Corp		[illegible]	Luzerne.
Carbondale Coal Co., Inc.[4]	78 Cottage St. Carbondale, Pa. 18407	[illegible]	Lackawanna.
Gangloff Brothers	New Ringgold, P[illegible]	[illegible] bank	Dauphin.
Gangloff Brothers [4]		do	Northumberland.
Glen-Nan Coal Co., Inc	St. Mary[illegible] Wilkes-B[illegible]	Underground and strip.	Luzerne.
Greenwood Stripping Corp	One Veni[illegible] Nesqueho[illegible] 18240	Underground	Carbon and Schuylkill.
Jeddo-Highland Coal Co.[8]	800 Exete[illegible]e. W. Pittston, Pa. 18643	Strip	Luzerne.
Jeddo-Highland Coal Co		Culm bank	Do.
Kerris & Helfrick, Inc	Lehigh & Popular St. Mt. Carmel, Pa. 18751	Strip	Columbia.
Kerris & Helfrick, Inc.[8]		do	Northumberland.
Lehigh Valley Anthracite, Inc.	800 Exeter Ave. W. Pittston, Pa. 18643	Culm bank	Carbon and Schuylkill.
Do		Strip	Columbia and Schuylkill.
Do.[4]		Strip	Luzerne.
Do.[9]		Culm bank	Do.
Pennsylvania Power & Light Co.	901 Hamilton St. Allentown, Pa. 18101	Dredge	Lancaster.
Ken Pollock, Inc.[4]	Route 11 Hunlock Creek, Pa. 18621	Culm bank	Luzerne.
Reading Anthracite Co.[4]	200 Mahantongo St. Pottsville, Pa. 17901	do	Northumberland.
Reading Anthracite Co		Strip	Do.
Do.[9]		do	Schuylkill.
Do.[8]		Culm bank	Do.
Bituminous:			
Barnes & Tucker Co.[7]	357 Lancaster Ave. Haverford, Pa. 19041	Underground	Cambria.
Barnes & Tucker Co		do	Indiana.
Bethlehem Mines Corp.[8]	701 E. 3d St. Bethlehem, Pa. 18016	do	Cambria.
Do.[7]		do	Washington.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal—Continued			
Bituminous—Continued			
Buckeye Coal Co	P.O. Box 900 Youngstown, Ohio 44501	Underground	Greene.
Gateway Coal Co. for J & L	Box 608 California, Pa. 15419	do	Do.
Harmar Coal Co.[4]	Box 500 Library, Pa. 15129	do	Allegheny.
Jones & Laughlin Steel Corp.	Box 608 California, Pa. 15419	do	Greene.
Mathies Coal Co	Box 500 Library, Pa. 15129	do	Washington.
Pittsburgh Coal Co.[4]		do	Do.
United States Steel Corp.[7]	525 Wm. Penn Place Pittsburgh, Pa. 15219	do	Greene.
Do.[4]		do	Washington.
Graphite (synthetic): Stackpole Carbon Co.	St. Marys, Pa. 15857	Plant	Elk.
Gypsum (calcined): United States Gypsum Co.[10]	101 S. Wacker Dr. Chicago, Ill. 60606	do	Philadelphia.
Iron ore:			
Bethlehem Mines Corp.[11]	701 E. 3d St. Bethlehem, Pa. 18016	Underground	Berks.
Do.[12]		do	Lebanon.
Iron oxide pigments:			
Crude:			
Allegheny Ludlum Steel Corp.	2000 Oliver Bldg. Pittsburgh, Pa. 15222	Plant	Allegheny.
Lanzendorfer Minerals Co	Twin Rocks, Pa. 15960	Pit	Cambria.
Finished:			
Minerals, Pigments, & Metals Div., Chas. Pfizer & Co., Inc.	640 North 13th St. Easton, Pa. 18042	Plant	Northampton.
The Prince Manufacturing Co.	Bowmanstown, Pa. 18030	do	Carbon.
Reichard-Coulston, Inc	15 East 26th St. New York, N.Y. 10010	do	Northampton.
Lime:			
Primary:			
Baker Stone Co.[1]	R.D. 5 Bloomsburg, Pa. 17815	do	Columbia.
The J. E. Baker Co.[1]	P.O. Box 1189 York, Pa. 17405	do	York.
Mercer Lime & Stone Co	Branchton, Pa. 16021	do	Butler.
National Gypsum Co.[1]	325 Delaware Ave. Buffalo, N.Y. 14202	do	Centre.
Standard Lime & Refrac. Co., Div. Martin Marietta Corp.[1]	2000 First Nat'l. Bank Bldg. Baltimore, Md. 21203	do	Do.
Warner Company [1]	1721 Arch St. Philadelphia, Pa. 19103	do	Centre and Chester.
Regenerated:			
Combined Paper Mills, Inc	Roaring Spring, Pa. 16673	do	Blair.
P. H. Glatfelter Co	Spring Grove, Pa. 17362	do	York.
Hammermill Paper Co	Lock Haven, Pa. 17745	do	Clinton.
West Virginia Pulp & Paper Co.	Tyrone, Pa. 16686	do	Blair.
Mica (residual): Micalith Mining Co., Inc.	P.O. Box 1671 Phoenix, Ariz. 85001	Pit	York.
Peat:			
Benton Peat	Benton, Pa. 17814	Bog	Columbia.
Blue Ridge Industries, Inc	Box 128, R.D. 2 White Haven, Pa. 18661	Bog	Luzerne.
D. M. Boyd Co	226 Francis St. New Wilmington, Pa. 16142	Bog	Mercer.
Corry Peat Products Co	515 W. Columbus Ave Corry, Pa. 16407	Bog	Erie.
International Peat, Inc	R.D. 1 White Haven, Pa. 18661	Bog	Monroe.
Pennsylvania Peat Moss, Inc	21st. & Laurel Sts. Hazelton, Pa. 18201	Bog	Luzerne.
Stillers Blue Ridge Peat Co	R.D. White Haven, Pa. 18661	Bog	Do.
Wayne Peat Humus Co., Inc	P.O. Box 315 Gouldsboro, Pa. 18424	Bog	Wayne.
Welker's Greenhouse, Inc	New Castle, Pa. 16101	Bog	Lawrence.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Perlite (expanded):			
C-E Refractories	Port Kennedy, Pa. 19463	Plant	Montgomery.
Insul-Fil Manufacturing Co.	Box 325 Primos, Pa. 19018	do	Delaware.
Pennsylvania Perlite Corp	P.O. Box 2002 Lehigh Valley, Pa. 18001	do	Lehigh and York.
Perlite Manufacturing Co.	P.O. Box 478 Carnegie, Pa. 15106	do	Allegheny.
Petroleum refineries:			
Atlantic Richfield Co.	260 S. Broad St. Philadelphia, Pa. 19102	do	Philadelphia.
Franklin Refinery, Div. of Sonneborn Sons, Inc.	Franklin, Pa. 16323	do	Venango.
Gulf Oil Corp	P.O. Box 7408 Philadelphia, Pa. 19101	do	Erie.
Kendall Refining Co., Div. of Witco Chemical Co.	Bradford, Pa. 16701	do	McKean.
Pennsylvania Refining Co.	Karns City, Pa. 16041	do	Butler.
Pennzoil Company	Oil City, Pa. 16301	do	Venango.
Quaker State Oil Refining Corp.	Farmers Valley, Pa. 16749	do	McKean and Venango.
Sinclair Oil Corp	600 Fifth Ave. New York, N.Y. 10001	do	Delaware.
Sun Oil Company	1608 Walnut St. Philadelphia, Pa. 19101	do	Do.
United Refining Co.	Warren, Pa. 16365	do	Warren.
Valvoline Oil Co., Div. of Ashland Oil and Refining Co.	Freedom, Pa. 15042	do	Beaver.
Wolf's Head Oil Refining Co., Inc.	Reno, Pa. 16343	do	Venango.
Sand and gravel:			
Davison Sand & Gravel Co.	34th Ave. & 4th St. New Kensington, Pa. 15068	Dredge	Westmoreland.
East Falls Sand & Gravel	R.D. 1 Falls, Pa. 18615	Pit	Wyoming.
Emlenton Limestone Co., Inc.	Box 67 Emlenton, Pa. 16373	Pit	Armstrong.
Erie Sand Steamship Co.	Erie, Pa. 16500	Dredge	Erie.
Glacial Sand & Gravel Co.	P.O. Box 10 Kittanning, Pa. 16201	Pit	Armstrong and Clarion.
Lycoming Silica Sand Co.	401 Broad St., Box 159 Montoursville, Pa. 17754	Pit	Lycoming.
Manorville Sand Co.	Box 251 Manorville, Pa. 16238	Pit	Armstrong.
Mt. Cydonia Sand Co., Inc.	R.D. 1 Fayetteville, Pa. 17222	Pit	Franklin.
Oil City Sand & Gravel Co.	Wyllis & Front Sts. Oil City, Pa. 16301	Pit	Venango.
Pennsylvania Glass Sand Corp.	Hancock, W.Va. 25424	Pit	Huntingdon and Mifflin.
Pennsy Supply, Inc.	1001 Paxton St. Harrisburg, Pa. 17101	Pit	Douphin.
Seidle Sand & Gravel Inc.	R.D. 4 Mercer, Pa. 16137	Pit	Mercer.
State Aggregates, Inc.	635 Lucknow Lane Harrisburg, Pa. 17110	Pit	Bradford.
Tionesta Sand & Gravel, Inc.	Hawthorne, Pa. 16230	Pit	Forest.
Warner Co.	1721 Arch St. Philadelphia, Pa. 19103	Pit	Bucks.
Wyoming Sand & Stone Co.	Falls, Pa. 18615	Pit	Wyoming.
Smelters (zinc):			
The New Jersey Zinc Co.	Palmerton, Pa. 18071	Plant	Carbon.
St. Joseph Lead Co.	Josephtown, Pa. 15061	do	Beaver.
Stone:			
Limestone (crushed):			
Appalachian Stone Div. Martin Marietta Corp.	Box 120 Mercersburg, Pa. 17236	Quarry	Fayette.
Bethlehem Mines Corp.[13]	701 E. 3d St. Bethlehem, Pa. 18016	do	Adams and Lebanon.
Bethlehem Mines Corp.		do	Montgomery.
Bradford Hills Quarries, Inc.	Box 231 Easton, Pa. 18042	do	Chester.
G. & W. H. Corson, Inc.[14]	Plymouth Meeting, Pa. 19462	do	Montgomery.
Eureka Stone Quarry, Inc.	Lower State and Pickertown Rds. Eureka, Pa. 18914	do	Bucks.
Eastern Industries Inc.	Box 188 Wescosville, Pa. 18090	do	Berks.
National Gypsum Co.	325 Delaware Ave. Buffalo, N.Y. 14202	do	York.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Sechan Limestone Co	R.D. 1 Prospect, Pa. 16052	Quarry	Butler.
Thomasville Stone & Lime Co.	Thomasville, Pa. 17364	Underground and quarry.	York.
United States Steel Corp	Hillsville, Pa. 16132	Quarry	Lawrence.
Miscellaneous (crushed):			
Better Materials Corp	Route 232 & Swamp Rd. Penns Park, Pa. 18943	do	Bucks.
Gill Quarries, Inc	P.O. Box 187 Fairview Village, Pa. 19434	do	Bucks and Montgomery.
M & M Stone Co	Harleysville, Pa. 19438	do	Montgomery.
Miscellaneous (dimension):			
Burdo & Burdo	29 Washington Ave. Belmont Heights Philadelphia, Pa. 19100	do	Do.
F. Cantono & Sons	454 Germantown Pike Lafayette Hill, Pa. 19444	do	Delaware.
Di Bonaventura Quarries Inc.	4989 W. Thompson St. Philadelphia, Pa. 19131	do	Do.
Oystershell (crushed): Reading Poultry Food Co	Orrton & Noble Sts. Reading, Pa. 19600	Plant	Berks.
Sandstone (crushed):			
American Asphalt Paving Co.	Box 95, R.D. 5 Shavertown, Pa. 18700	Quarry	Luzerne.
Connellsville Bluestone Co	Box 20 Scottdale, Pa. 15683	do	Fayette.
Coolbaugh Sand & Stone, Inc.	32 Railroad Ave. Scranton, Pa. 18505	do	Luzerne.
Detwilers Industries, Inc	New Enterprise, Pa. 16664	do	Bedford and Somerset.
Eidemiller Enterprises, Inc	Greensburg, Pa. 15601	do	Westmoreland.
Harbison-Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15219	do	Huntingdon and Schuylkill.
Keelor Supply Co., Inc	Box 12 Clifford, Pa. 18413	do	Susquehanna.
Latrobe Construction Co	P.O. Box 150 Latrobe, Pa. 15650	Underground	Westmoreland.
North American Refractories Co.	6th Street Bldg. Cleveland, Ohio 44114	Quarry	Carbon and Huntingdon.
No. 1 Contracting Corp. of Delaware.	Box 460 Pittston, Pa. 18640	do	Luzerne and Northampton.
State Aggregates, Inc	635 Lucknow Lane Harrisburg, Pa. 17110	do	Susquehanna.
Summit Quarries, Division of J. Robert Bazley, Inc.	P.O. Box 637 Pottsville, Pa. 17901	do	Schuylkill.
Sandstone (dimension):			
Delaware Quarries	Lumberville, Pa. 18933	do	Bucks.
Firestone Products Co., Inc.	300 Willow Grove Ave. Glenside, Pa. 19038	do	Montgomery.
Martin Stone Quarries	Box 157 Bechtelsville, Pa. 19505	do	Susquehanna.
Media Quarry Co	131 E. 2d St. Media, Pa. 19063	do	Delaware.
Penn Kress Flagstone Co., Inc.	Bridge St. Pittsburgh, Pa. 15209	do	Potter.
Powers Bros. Quarries	R.D. 5 Montrose, Pa. 18801	do	Susquehanna.
J. G. Robinson, Inc	P.O. Box 6 Fort Washington, Pa. 19034	do	Wyoming.
Paul Tompkins Estate	Hancock, N.Y. 13783	do	Wayne.
Valley Forge Building Stone Co.	P.O. Box 195 Morgantown, Pa. 19543	do	Chester.
Slate (crushed):			
GAF Corp., Bldg., Indust. & Floor Products Division.	140 West 51st St. New York, N.Y. 10020	do	York.
Pennsylvania Lightweight Aggregate, Inc.	Bangor, Pa. 18013	Plant	Northampton.
Slate (dimension):			
Albion Vein Slate Co	Bangor, Pa. 18013	Quarry	Do.
Capitol Slate Co., Inc	P.O. Box 281 East Bangor, Pa. 18040	do	Do.
Anthony Dally & Sons Inc.	Robinson Ave. Pen Argyl, Pa. 18072	do	Do.
Diamond Slate Co	P.O. Box 598 Pen Argyl, Pa. 18072	do	Do.
Doney Slate Co	Pen Argyl, Pa. 18072	do	Do.
Emerald Slate Corp	Alpha Road Wind Gap, Pa. 18091	do	Do.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Slate (dimension)—Continued			
North Bangor Slate Co	Bangor, Pa. 18013	Quarry	Do.
Penn Big Bed Slate Co., Inc.	446 Main St. Slatington, Pa. 18080	do	Lehigh.
Stephens-Jackson Co	Maine St. & Schanck Ave. Penn Argyle, Pa. 18072	do	Northampton.
D. Stoddard & Sons, Inc	Bangor, Pa. 18013	do	Do.
Traprock (basalt) Crushed:			
Bradford Hills Quarries, Inc.	Box 231 Easton, Pa. 18042	do	Berks.
Bucks County Crushed Stone, Inc.	Ottsville, Pa. 18942	do	Bucks.
V. Di Francesco & Sons	17 Mifflin Ave. Havertown, Pa. 19083	do	Chester and Delaware.
The John T. Dyer Quarry Co.	Box 188 Birdsboro, Pa. 19508	do	Berks.
Faylor Lime & Stone Co	Winfield, Pa. 17889	do	Dauphin.
GAF Corp., Bldg., Indust. & Floor Products Division.	140 West 51st St. New York, N.Y. 10020	do	Adams.
The General Crushed Stone Co.	712 Drake Bldg. Easton, Pa. 18042	do	Bucks and Delaware.
Vernon B. Horn	R.D. Chalfont, Pa. 18914	do	Bucks.
Keystone Trappe Rock Co	Glenmoore, Pa. 19343	do	Chester.
Kibblehouse Quarries, Inc	Perkiomenville, Pa. 18074	do	Montgomery.
Montgomery Stone Co., Inc.[15]	Montgomeryville, Pa. 18936	do	Do.
Pottstown Trap Rock Quarries, Inc.	R.D. 1 Douglasville, Pa. 19518	do	Berks and Montgomery.
Tohickon Quarry Co	Quakertown, Pa. 18951	do	Bucks.
Traprock (basalt)—Dimension:			
Coopersburg Granite Co	Coopersburg, Pa. 18036	do	Do.
French Creek Granite Co	St. Peters, Pa. 19470	do	Chester.
Granite (crushed):			
Mignatti Constr. Co., Inc	2310 Terwood Ave. Bethayres, Pa. 19006	do	Montgomery.
Granite (dimension):			
Carl Galantino, Inc	42 Hirst Ave. E. Lansdowne, Pa. 19050	do	Delaware.
Marcolina Bros., Inc	133 E. Mermaid Lane Chestnut Hill, Pa. 19118	do	Montgomery.
Sulfur:			
Atlantic Richfield Co	260 S. Broad St. Philadelphia, Pa. 19102	Plant	Philadelphia.
Gulf Oil Corp	P.O. Box 7408 Philadelphia, Pa. 19101	do	Do.
Sinclair Oil Corp	600 Fifth Ave. New York, N.Y. 10020	do	Delaware.
Sun Oil Co	1608 Walnut St. Philadelphia, Pa. 19103	do	Do.
Talc (sericite schist): Summit Industries, Inc.	Drawer C Aspers, Pa. 17304	Pit	Adams.
Tripoli (rottenstone):			
Keystone Filler & Mfg .Co	Muncy, Pa. 17756	Pit	Lycoming.
Penn Paint & Filler Co	Antes Fort, Pa. 17720	Pit	Do.
Vermiculite (exfoliated):			
Hyzer & Lewellen	P.O. Box 155 Southampton, Pa. 18966	Plant	Bucks.
Zonolite Division, W. R. Grace & Company.	62 Whittemore Ave. Cambridge, Mass. 01109	do	Lawrence.
Zinc: The New Jersey Zinc Co.[1]	160 Front St. New York, N.Y. 10038	Underground	Lehigh.

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[1] Also limestone.
[2] Also limestone and shale.
[3] Also limestone and clay.
[4] 2 operations.
[5] Also limestone and sand and gravel.
[6] Also miscellaneous clays.
[7] 3 operations.
[8] 5 operations.
[9] 4 operations.
[10] Also expanded perlite.
[11] Also byproduct cobalt and pyrites.
[12] Also byproduct gold, silver, copper, cobalt, and pyrites.
[13] Also lime.
[14] Also cement and lime.
[15] Also dimension.

The Mineral Industry of Puerto Rico, the Panama Canal Zone, the Virgin Islands, Pacific Island Possessions, and Trust Territory of the Pacific Islands

The Puerto Rico section of this chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Mineralogy and Geology Section, Industrial Research, Economic Development Administration, Commonweath of Puerto Rico, for collecting information on all minerals.

By Harry F. Robertson,[1] Eduardo Aguilar,[2] and Roy Y. Ashizawa [3]

PUERTO RICO [4]

Mineral production value in Puerto Rico advanced from $63 million to $68 million. The gain indicated increased construction activity as registered by output of sand and gravel, stone, clay, and cement.

The Federal and Commonwealth Governments agreed to conduct a study on the feasibility of creating nuclear energy centers in Puerto Rico. Each operation would be located in a coastal region and involve a complex including a nuclear powerplant, a water desalting plant, and associated facilities. The experimental nuclear plant at Rincón was deactivated, reverting to demonstration status.

The Geologic Division of the U.S. Geological Survey, working under a cooperative agreement with the Puerto Rico Economic Development Administration (PREDA), continued a program of preparing geologic maps of several 7½-minute quadrangles of the island. Reports were published on the geology of the Arecibo, Adjuntas, Jayuya,

Table 1.—Mineral production in Puerto Rico[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement thousand 376-pound barrels	8,447	$27,397	8,923	$27,577
Clays thousand short tons	291	244	512	481
Lime do	35	1,106	39	1,187
Salt do	12	195	32	395
Sand and gravel do	14,101	21,633	16,146	24,723
Stone do	7,269	12,795	7,367	13,580
Total	XX	63,370	XX	67,943
Total 1957–59 constant dollars	XX	[r] 61,156	XX	[p] 65,172

XX Not applicable. [r] Revised. [p] Preliminary.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

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[1] Supervisory mining engineer, Bureau of Mines, Bartlesville, Okla.

[2] Chief, Mineralogy and Geology Section, Economic Development Administration, Commonwealth of Puerto Rico.

[3] Mineral specialist, Bureau of Mines, San Francisco, Calif.

[4] Prepared by Harry F. Robertson and Eduardo Aguilar.

Table 2.—Value of mineral production in Puerto Rico, by districts

(Thousands)

Senatorial district	1967	1968	Minerals produced in 1968, in order of value
Aguadilla	$1,583	$1,683	Stone, sand and gravel.
Arecibo	1,424	1,538	Do.
Guayama	4,698	4,560	Sand and gravel, stone.
Humacao	993	1,078	Stone, sand and gravel.
Mayaguez	4,113	4,330	Sand and gravel, stone, salt.
Ponce	22,108	23,572	Cement, sand and gravel, stone, lime, clay.
San Juan	28,451	31,182	Cement, sand and gravel, stone, clay.
Total	63,370	67,943	

Bayaney, Buenas, and Naranjito quadrangles.[5]

Results of stratigraphic studies in east-central and northwestern Puerto Rico were published.[6]

The Water Resources Division of the U.S. Geological Survey, in cooperation with Puerto Rico, studied the water resources of the island and published maps delineating the boundaries of floods at Arecibo and Mayaguez.

San Juan Cement Co., Inc., began construction of a new plant at Dorado, just west of San Juan. Annual capacity of the completed plant will be 2.3 million barrels of cement. The wet process will be used. The Puerto Rican Cement Co. Inc. began installing dust-filtering equipment in the stacks of its San Juan plant. Electrostatic precipitators will assist in decreasing air pollution.

Aluminum Company of America (Alcoa) and the Puerto Rican Government discussed construction by Alcoa of a major aluminum smelter at Tortugero. Alumina would be imported.

Alcoa announced plans for a 250,000-gallon-per-day, all-aluminum desalination plant near Penuelas on the south shore of Puerto Rico.

Commonwealth Oil Refining Co., Inc. (Corco), announced plans for construction of a 2.5-million-gallon-per-day water desalination plant at its Penuelas works. The desalinized water will be used as feedwater for the power generation boilers in the Corco oil refining and petrochemical complex. Completion was scheduled by early 1970. Corco also planned construction ot a 10th unit in its petrochemical complex at Penuelas. The new unit will be financed jointly with W. R. Grace & Co.; production capacity will be about 70 million pounds of phthalic anhydride annually.

Pittsburgh Plate Glass Industries and Corco were planning a petrochemical complex at Guayanilla to include a 500-million-pound-per-year vinyl chloride unit, a 400-million-pound-per-year ethylene glycol facility, and a chlorine-caustic plant with production capacities of about 185,000 tons of chlorine and more than 200,000 tons of caustic per year. The complex was to be completed by late 1970.

Government-company negotiations for exploiting copper deposits at Utuado and Lares continued. Royalty rates, air and water pollution control, and construction of a smelter, refinery, and sulfuric acid plant were included in the discussions between PREDA, Ponce Mining Corp., and Cobre Caribe.

The Puerto Rican Government announced plans for a system of dams on the Toa Vaca and Buata Rivers. Objective of the project is to supply 114 million gallons of water per day to the arid south and southwest regions of the island. The water would be available for municipal, industrial, and agricultural uses.

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[5] Briggs, R. P. Geologic Map of the Arecibo Quadrangle, Puerto Rico, Misc. Geol. Inv. Map No. I-551. U.S. Geol. Survey, 1968.

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———. Geologic Map of the Jayuya Quadrangle, Puerto Rico. Misc. Geol. Inv. Map No. I-520. U.S. Geol. Survey, 1968.

Nelson, A. E., and O. T. Tobisch. Geologic Map of the Bayaney Quadrangle, Puerto Rico. Misc. Geol. Inv. Map No. I-525. U.S. Geol. Survey, 1968.

Pease, M. H., Jr. Geologic Map of the Aguas Buenas Quadrangle, Puerto Rico. Misc. Geol. Inv. Map No. I-479. U.S. Geol. Survey, 1968.

———. Geologic Map of the Naranjito Quadrangle, Puerto Rico. Misc. Geol. Inv. Map No. I-508. U.S. Geol. Survey, 1968.

[6] Monroe, W. H. The Aguada Limestone of Northwestern Puerto Rico. U.S. Geol. Survey Bull. 1274-G, 1968, pp. G1-G12.

———. High Level Quaternary Beach Deposits in Northwestern Puerto Rico. U.S. Geol. Survey Prof. Paper 600-C, 1968, pp. C140-C143.

Nelson, A. E. Intrusive Rocks of North-Central Puerto Rico. U.S. Geol. Survey Prof. Paper 600-B, 1968, pp. B16-B20.

Pease, M. H., Jr. Stratigraphy of the Naranjito and Aguas Buenas Quadrangles, Puerto Rico. U.S. Geol. Survey Bull. 1253, 1968, 57 pp.

REVIEW BY MINERAL COMMODITIES

Nonmetals.—*Cement.*—The upward trend of the construction industry resulted in increased shipments of portland cement. Domestic production gained while imports —mostly from Colombia, Belgium, Luxembourg, and Japan—dropped about 3 percent. Virtually all cement produced in Puerto Rico in 1968 was sold; beginning and ending stock totals varied less than 1,000 barrels at the two plants. Most of the cement was sold to building material dealers and ready-mix concrete companies. Concrete is a major component of residential and nonresidential construction on the island.

The Puerto Rican Cement Co. Inc. converted a kiln, 9 feet in diameter and 335 feet long, to the production of white cement, a specialty product with good demand.

Table 3.—Portland cement production and shipments

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments		
		Quantity	Value	
			Total	Average per barrel
1964	7,911	7,926	$23,879	$3.01
1965	7,269	7,284	23,415	3.21
1966	8,071	7,603	24,277	3.19
1967	7,963	8,447	27,397	3.24
1968	8,924	8,923	27,577	3.09

Clay.—Output of common clay gained substantially compared with that of last year. Puerto Rican Cement Co., Inc., accounted for most of the increase by producing clay for making cement at the San Juan and Ponce plants.

Diazlite, Inc., processed clay with an oil additive to make lightweight aggregate at its plant near Trujillo Alto. The company planned installation of a second rotary kiln to increase plant capacity. Fines from the operation have a potential use as a substitute for sand.

Lime.—Puerto Rican Cement Co., Inc., processed high-grade limestone into quicklime and hydrated lime at Ponce. Most of the hydrated lime was used for sugar refining, for water purification and softening (municipal and industrial), and in alumina production. The quicklime was used principally as a fluxing agent in electric steel furnaces.

Salt.—Salt was recovered from sea water by Sal De Borinquen, Ponce Salt Industries, and other producers along the southwest coast. Sea water is passed through a series of evaporating ponds to increase salinity to the precipitating point. Crude salt was imported from Gran Inagua.

Sand and Gravel.—Increased sand and gravel output corresponded with gains in construction activity. Silica sand from inland deposits west of San Juan was used in nearby cement and glass plants, in foundries, in sandblasting, and in marble polishing. Puerto Rico Glass Corp. used white, high-grade silica sand in making bottles and jars.

The search for new sources of sand for construction continued as environmental conditions necessitated limiting exploitation of known beach and river sands. The Department of Public Works requested legislation to govern mining of sand on public and private lands.

Stone.—Increased requirements of the cement industry caused a corresponding increase in crushed limestone production at quarries near the cement plants at San Juan and Ponce. Andesite, tuffaceous siltstone, and other volcanic stones were mined in all districts except Arecibo. Granite was produced in Humacao and Guayama Districts. Marble from various parts of the Island was sawed and polished to make slabs and shapes by Marmoles Cienne at a plant west of Bayamon.

Mineral Fuels.—Crude and unfinished oil imported from Venezuela and Netherlands Antilles averaged 168,600 barrels per day, up 7 percent from the 1967 imports. Caribbean Gulf Refining Corp. at Cataño and Commonwealth Oil Refining Co. at Guayanilla refined crude and unfinished oils; Phillips Petroleum Co. at Guayama refined only unfinished oils.

Sun Oil Co. received an import quota of 66,000 barrels of crude oil per day for a proposed refinery and petrochemical plant in Puerto Rico. The privilege of shipping 29,500 barrels per day of finished and unfinished products to the United States was included. The company contracted for construction of a crude oil refinery and a lubricating oil facility as the initial units in its planned petrochemical complex at Yabucoa, southeast Puerto Rico. Harbor

Table 4.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,065	$5,982	3,269	$6,554
Paving	2,360	3,249	3,032	3,678
Fill	960	817	1,064	920
Total	6,385	10,048	7,365	11,152
Gravel:				
Building	2,779	5,108	2,798	5,336
Paving	3,006	4,428	3,352	5,488
Fill	577	490	735	679
Total	6,362	10,026	6,885	11,503
Total sand and gravel	12,747	20,074	14,250	22,655
Government-and-contractor operations:				
Sand:				
Building	8	15	4	8
Paving	413	604	565	803
Fill	485	410	624	522
Total	906	1,029	1,193	1,333
Gravel:				
Building	9	13	5	10
Paving	265	371	338	468
Fill	174	146	360	257
Total	448	530	703	735
Total sand and gravel [1]	1,354	1,558	1,896	2,066
Grand total [1]	14,101	21,633	16,146	24,723

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Stone sold or used by producers

(Thousand short tons and thousand dollars)

Year	Dimension limestone		Crushed limestone [1]		Miscellaneous stone [2]		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1964	75	$191	4,347	$6,009	1,082	$2,386	5,504	$8,586
1965	74	180	4,236	6,607	1,034	2,324	5,344	9,111
1966	88	231	4,416	7,555	1,228	2,755	5,732	10,541
1967	101	293	5,578	8,767	1,590	3,735	7,269	12,795
1968	101	293	5,619	9,408	1,647	3,879	7,367	13,580

[1] Includes limestone for cement and lime.
[2] Includes granite, marble, and miscellaneous stone.

facilities will be constructed to accommodate 50,000- to 60,000-ton tankers.

Metals.—Industrial Siderurgica, Inc., produced various sizes of steel reinforcing bars at its steel mill near Cataño for concrete construction. Domestic and imported iron and steel scrap was melted in two 20-ton electric furnaces.

Aluminum Company of America and the Puerto Rican Government announced plans for an aluminum smelter at Tortuguero. Residual oil would be used as fuel for a plant to generate the electricity for refining aluminum.

Discussions continued by company and Government officials on formulation of a contract to allow exploitation of copper deposits near Utuado and Lares.

PANAMA CANAL ZONE [7]

The value of mineral production in the Panama Canal Zone gained as compared with that of 1967. Sand and gravel and stone used as roadstone and concrete aggregate comprised the mineral output.

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[7] Prepared by Harry F. Robertson.

Table 6.—Mineral production in the Panama Canal Zone and Virgin Islands [1]

Mineral	1967 Short tons	1967 Value	1968 Short tons	1968 Value
Canal Zone:				
Sand and gravel	56,000	$94,000	55,000	$77,000
Stone [2]	100,476	245,010	106,130	290,208
Total	XX	339,010	XX	367,208
Total 1957–59 constant dollars	XX	[r] 327,230	XX	[p] 352,407
Virgin Islands:				
Stone (basalt)	182,974	850,906	365,677	1,555,007
Total 1957–59 constant dollars	XX	[r] 821,338	XX	[p] 1,492,329

[r] Revised. XX Not applicable. [p] Preliminary.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Includes basalt.

VIRGIN ISLANDS [8]

Basalt was mined and crushed for concrete aggregate, roadstone, and riprap. Quarries on the northwest end of St. Croix and on St. Thomas accounted for the stone output.

Hess Oil and Chemical Corp. continued construction of the first plant in its petrochemical complex on St. Croix. The complex will include a 30,000-barrel-per-day vacuum gas oil desulfurization plant and an 18,000-barrel-per-day benzene-toluene-xylene (BTX) plant. Other related, but as yet unspecified type, petrochemical facilities will be constructed in the next 3 years.

The alumina plant of Harvey Aluminum, Inc., near Christiansted, St. Croix, operated during the year. Imported bauxite was processed.

PACIFIC ISLAND POSSESSIONS [9]

American Samoa.—Government crews mined sand, coral, and volcanic cinders for use in various building and paving projects. Requirements of concrete and asphalt aggregates were processed at plants situated in the Tafuna Public Works Compound. A dredge, rented from Western Samoa, was utilized to obtain coral fill material for development of Utulei Beach, Pago Pago Park, and a boat marina.

Guam.—Coral limestone was quarried on Guam for civilian and military construction projects. Commercial producers of crushed coral and coral fines operated plants at Agana and Oka. Government crews and contractors on airfield and jetty improvement projects utilized dense graded coral for fill and as base material.

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[8] Prepared by Harry F. Robertson.
[9] Prepared by Roy Y. Ashizawa.

Table 7.—Mineral production in the Pacific Island Possessions

Area and mineral	1967 Short tons	1967 Value	1968 Short tons	1968 Value
American Samoa:				
Pumice (volcanic cinder)	27,899	$23,714	20,535	$51,338
Sand	7,000	7,000	20,000	19,000
Stone	28,306	49,536	52,718	79,077
Total	XX	80,250	XX	149,415
Guam: Stone	511,517	820,407	559,529	998,032
Wake: Stone	31,500	150,000	41,000	132,000

XX Not applicable.

Wake.—Construction and maintenance crews and contractors used dredged coral as base material for improvement of roads and airfield taxiways. Processed aggregates for concrete and asphalt were supplied mainly from Hawaii.

Other Pacific Island Possessions.—No mineral production was reported on the islands of Canton, Enderbury, Jarvis, Johnston, Midway, and Palmyra. Road graders and other maintenance equipment left on Canton in 1967, when the National Aeronautics and Space Administration closed its small Gemini tracking station, were transferred to American Samoa. Mineral material requirements for construction and maintenance of facilities on Johnston and Midway were supplied by contractors from Hawaii and the U.S. mainland.

TRUST TERRITORY OF THE PACIFIC ISLANDS [10]

The Trust Territory of the Pacific Islands is administered by the United States through a trusteeship agreement with the United Nations Security Council. The territory is comprised of 2,141 islands, a land area of 700 square miles in an ocean area of 3 million square miles.

Phosphate and bauxite deposits exist on several of the islands in the Palau and Yap Districts. A mining company from the United States explored the possibility of producing phosphate from the Palau lagoons but found the venture to be uneconomical. Government crews and contractors quarried or dredged volcanic rock and coral stone and sand for building and paving uses. New rock crushing operations were established on the islands of Koror and Truk. The introduction of jet air service to the territory in May created additional maintenance problems, particularly on Majuro, as the weight of the heavy aircraft on landing and the blast of the jets on takeoff repeatedly damaged the coral surface of the airstrip. Repairs to roads, washed out by heavy rainfalls, also was of continual concern to the public works forces.

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[10] Prepared by Roy Y. Ashizawa.

The Mineral Industry of Rhode Island

By Arthur Sykes Lees [1]

Commercial mineral production in 1968 was limited to sand and gravel and stone. Noncommercial mineral specimens and gem stones were collected by hobbyists. The value of sand and gravel comprised 60 percent of the total value. Stone, including miscellaneous crushed stone, dimension granite and limestone, and crushed limestone, accounted for the remainder.

Sand and gravel producers reported a slight decrease in output with a slight increase in value compared with 1967 production and value, responding to slightly higher unit prices. Stone producers reported a 16-percent reduction in output with about a 4-percent increase in value, compared with that of the previous year.

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[1] Mining engineer, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Value of mineral production in Rhode Island, by counties [1]

(Thousand dollars)

County	1967	1968	Minerals produced in 1968, in order of value
Kent	W	W	Sand and gravel.
Newport	$52	$90	Sand and gravel, stone.
Providence	1,900	1,820	Do.
Washington	W	W	Stone, sand and gravel.
Undistributed [2]	2,083	2,312	
Total	4,035	4,222	
Total, 1957-59 constant dollars	3,895	p 4,052	

p Preliminary. W Withheld to avoid disclosing individual company confidential data.

[1] Bristol County is not listed because no production was reported.

[2] Includes value of gem stones and sand and gravel that cannot be assigned to specific counties and values indicated by symbol W.

Table 2.—Indicators of Rhode Island business activity

	1967	1968	Change (percent)
Employment and labor force, annual average:			
Total labor force……thousands..	387.3	391.8	+1.2
Unemployment……percent of work force..	3.7	3.6	—2.7
Employment:			
Manufacturing……thousands..	127.4	127.0	—.3
Textiles……do….	22.6	22.8	+.9
Metals and machinery……do….	39.8	38.8	—2.5
Jewelry and silverware……do….	19.7	19.5	—1.0
Other non-textile……do….	45.3	45.9	+1.3
Nonmanufacturing……do….	210.9	216.6	+2.7
Construction……do….	15.6	15.2	—2.6
Service (including mining)……do….	51.1	53.8	+5.3
Payroll: Average weekly earnings (manufacturing products)……	$102.06	$96.79	—5.2
Personal income:			
Total……millions..	$2,995	$3,233	+7.9
Per capita……	3,324	3,537	+6.4
Construction activity:			
New housing units authorized……	4,929	5,339	+8.3
Cement shipments to and within Rhode Island thousand 376-pound barrels..	1,225	1,090	—11.0
Mineral production……thousands..	$4,035	$4,222	+4.6

Source: Survey of Current Business, U.S. Department of Commerce.
Rhode Island Department of Employment Security.
U.S. Bureau of Mines.
Bureau of the Census, U.S. Department of Commerce.
Construction Reports, U.S. Department of Commerce.

Table 3.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Sand and gravel……	204	191	39	312	…….	3	9.60	189
Stone……	47	234	11	98	…….	4	41.02	728
Total……	251	199	50	410	…….	7	17.08	317
1968:[p]								
Sand and gravel……	200	191	38	306	…….	7	22.91	288
Stone……	70	251	18	148	…….	3	20.28	1,054
Total……	270	207	56	454	…….	10	22.05	538

[p] Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Gem Stones.—Some mineral specimens were recovered, including bowenite, a precious variety of serpentine and the Rhode Island State stone; agate; flourescent calcite; sulfides; and various pegmatite minerals. Most of the specimens were collected from quarries and from quarry and mine dumps in the northern part of the State.

Sand and Gravel.—Production in 1968 decreased almost 2 percent in quantity, but increased 5 percent in value compared with that of 1967. Fifteen operations produced nearly 2.3 million tons valued at over $2.5 million from the counties of Kent, Providence, Washington, and Newport, listed in order of production. Sand accounted for about 45 percent and gravel 55 percent of the production.

Stone.—Production of stone in 1968 included granite, limestone, and miscellaneous stone. The miscellaneous stone consisted of granitized gneiss and conglomerate. Granite production was up 23 percent and

Table 4.—Principal uses and value of sand and gravel

Use	Sand		Gravel	
	Percent	Value (thousands)	Percent	Value (thousands)
Building construction	57	$738	47	$813
Paving	18	183	26	387
Fill	16	75	13	129
Other	9	106	14	115

Table 5.—Average value per ton, by use, of sand and gravel

Use	Sand	Gravel
Building construction	$1.25	$1.38
Paving	.99	1.19
Fill	.45	.81
Other	1.10	.65

the value up 28 percent over the same 1967 figures. Limestone production and value increased by 11 percent and 20 percent, while miscellaneous stone production and value were down 18 percent and 22 percent, respectively. Granite production consisted essentially of dimension stone. Limestone production was used principally as agricultural stone, terrazzo chips, roofing granules, ornamental stone, metallurgical flux, and mineral filler. A minor amount of dimension stone was produced. Miscellaneous stone products were principally crushed aggregate, riprap, mineral filler, and railroad ballast.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Petroleum:			
Mobil Oil Co	1001 Wampanoag Trail East Providence, R.I. 02915	Refinery	Providence.
Sand and gravel:			
A. Cardi Construction Co., Inc.	451 Arnold Rd. Coventry, R.I. 02816	Pit	Kent.
Del Bonis Sand & Gravel Co	950 Phenix Ave. Cranston, R.I. 02920	Pit	Providence.
Forte Brothers, Inc	14 Whipple St. Berkeley, R. I.	Pit	Do.
Lapham Sand & Gravel Co	R.F.D. 2, Greenville Rd. Woonsocket, R.I. 02895	Pit	Do.
Luigi Vallone, Inc	420 Bald Hill Rd. Apponaug, R.I. 02886	Pit	Kent.
Mack Sand & Gravel Co	Pawtucket, R.I. 02860	Pit	Providence.
Peckham Bros. Co., Inc	Paradise Ave. Middletown, R.I. 02840	Pit	Newport.
Rhode Island Sand & Gravel Co., Inc.	Kilvert St. Hillsgrove, R.I. 02886	Pit	Kent.
J. Romanella & Sons Inc	Westerly, R.I. 02891	Pit	Washington.
J. Santoro, Inc	11 Herbert Street Providence, R.I. 02909	Pit	Providence.
Silvestri Brothers, Inc	Shun Pike Johnston, R.I. 02919	Pit	Do.
South County Sand & Gravel Co., Inc.	North Rd., Peace Dale, R.I. 02881	Pit	Washington.
Tasca Sand & Gravel Co., Carmine Anthony Tasca.	204 Camden Ave. Providence, R.I. 02908	Pit	Providence.
Town Line Sand & Gravel, Anthony Ferrelli.	Victory Highway Slatersville, R.I. 02876	Pit	Do.
Whitehead Bros Co	60 Hanover Road Florham Park, N.J. 07932	Pit	Kent.
Stone:			
Granite, dimension: Providence Granite Co.	210 Kingsley Ave. Providence, R.I. 02903	Quarry	Washington.
Limestone, crushed [1]: The Conklin Limestone Co., Inc.	R.F.D. 1 Lincoln, R.I. 02865	do	Providence.
Miscellaneous stone, crushed:			
M.A. Gammino Construction Co.	875 Phenix Ave. Cranston, R.I. 02920	do	Do.
Peckham Brothers Co., Inc.	Paradise Ave. Newport, R.I. 02840	do	Newport.

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[1] Also dimension limestone.

The Mineral Industry of South Carolina

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the South Carolina Division of Geology, State Development Board, for collecting information on all minerals except fuels.

By Robert C. Johnson [1] and Henry S. Johnson, Jr. [2]

Mineral production value was a record $51.9 million in 1968, $3.6 million more than in 1967. The gain was due mostly to increased production of crushed granite, sand and gravel, kaolin, masonry cement, feldspar, scrap mica, pyrite, and vermiculite.

New production records were established for masonry cement, kaolin, feldspar, crushed granite, crushed limestone, and vermiculite. South Carolina ranked second among the States in the production of kaolin and vermiculite, third in kyanite, and fifth in feldspar.

South Carolina business activity in 1968 increased generally in line with the Nation's economic growth. However, per capita income in 1968 was $1,073 lower than the national figure of $3,412. Mineral production value was one of the leading growth segments of the State's economy.

Government Programs.—During 1968, the Division of Geology, South Carolina State Development Board, continued its basic program of investigations of the geology and mineral resources in Edgefield, Orangeburg, Newberry, Pickens, and McCormick Counties. During the year, 20 projects were active and 11 reports were published. Geologic mapping was in progress on the following 7½ minute quadrangles: Sumter West, Irmo NE, Wampee, James Island, Lake View, Dongola, Dovesville, Tamassee, Owdoms, Fair Play, Holly Springs, Whetstone, Old Pickens, Seneca, and Walhalla. The Myrtle Beach and Winnsboro 15-minute quadrangles were

Table 1.—Mineral production in South Carolina [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays __________ thousand short tons__	1,733	$8,048	1,936	$8,923
Sand and gravel __________ do____	5,248	7,178	5,662	8,074
Stone __________ do____	[2] 8,310	[2] 12,366	8,942	13,717
Value of items that cannot be disclosed: Cement, feldspar, kyanite, scrap mica, peat, pyrite, stone (dimension granite 1967), and vermiculite__________	XX	20,682	XX	21,144
Total__________	XX	48,274	XX	51,858
Total 1957–59 constant dollars__________	XX	[r] 45,206	XX	[p] 47,703

[p] Preliminary. [r] Revised. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes dimension granite; included with "Value of items that cannot be disclosed."

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[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.

[2] State geologist, Division of Geology, State Development Board, Columbia, S.C.

Table 2.—Value of mineral production in South Carolina, by counties[1]

(Thousand dollars)

County	1967	1968	Minerals produced in 1968 in order of value
Aiken	$6,678	$7,231	Kaolin, sand and gravel.
Cherokee	1,275	W	Limestone, miscellaneous clay, sand and gravel.
Chesterfield	W	W	Sand and gravel.
Colleton	W	W	Peat.
Dorchester	W	W	Cement, limestone, sand and gravel, miscellaneous clay.
Edgefield	W	W	Miscellaneous clay.
Fairfield	W	1,184	Granite, miscellaneous clay.
Florence	W	W	Sand and gravel.
Greenville	W	W	Granite, sand and gravel.
Greenwood	W	W	Granite, miscellaneous clay.
Horry	W	W	Sand and gravel, miscellaneous clay.
Jasper	W	W	Sand and gravel.
Kershaw	661	848	Sand and gravel, granite, kaolin, miscellaneous clay.
Lancaster	600	508	Mica, miscellaneous clay, sand and gravel.
Laurens	W	W	Vermiculite.
Lexington	W	4,216	Granite, sand and gravel, miscellaneous clay, kaolin.
Marion	W	W	Miscellaneous clay, sand and gravel.
Marlboro	W	W	Sand and gravel, miscellaneous clay, kaolin.
Newberry	------	W	Miscellaneous clay.
Orangeburg	W	W	Cement, limestone, miscellaneous clay.
Pickens	W	W	Granite.
Richland	W	1,913	Granite, kaolin, miscellaneous clay, sand and gravel.
Spartanburg	W	W	Granite, feldspar, sand and gravel, vermiculite.
Sumter	W	W	Sand and gravel, miscellaneous clay.
York	W	W	Kyanite, granite, pyrite.
Undistributed	39,060	35,958	
Total	48,274	51,858	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Abbeville, Allendale, Anderson, Bamberg, Barnwell, Beaufort, Berkeley, Calhoun, Charleston, Chester, Clarendon, Darlington, Dillon, Georgetown, Hampton, Lee, McCormick, Oconee, Saluda, Union, and Williamsburg.

Table 3.—Indicators of South Carolina business activity

	1967	1968	Change, percent
Employment and labor force, annual average:			
Total work force ... thousands	1,004.2	1,013.9	1.0
Unemployment ... do	46.8	44.6	−4.7
All employment ... do	957.4	968.7	1.2
Wage and salary employment:			
Mining ... do	1.7	1.6	−5.9
Contract construction ... do	48.1	48.2	.2
Manufacturing ... do	319.6	323.8	1.3
Transportation, communication, and public utilities ... do	31.2	32.8	5.1
Trade ... do	124.3	128.0	3.0
Finance, insurance and real estate ... do	25.9	26.3	1.5
Services ... do	75.3	76.6	1.7
Government ... do	128.3	133.7	4.2
Personal income:			
Total ... millions	5,752	$6,231	8.3
Per capita	$2,181	2,339	7.2
Construction activity:			
Total construction projects ... do	18.3	22.0	20.0
State Highway Department:			
Value of contracts, construction awards ... do	$64.9	$66.6	2.6
Farm marketing receipts ... do	$424.8	$376.3	−11.4
Mineral production value ... do	$48.3	$51.9	7.5

Sources: South Carolina Employment Security Commission, South Carolina State Highway Department, U.S. Department of Commerce, U.S. Bureau of Mines.

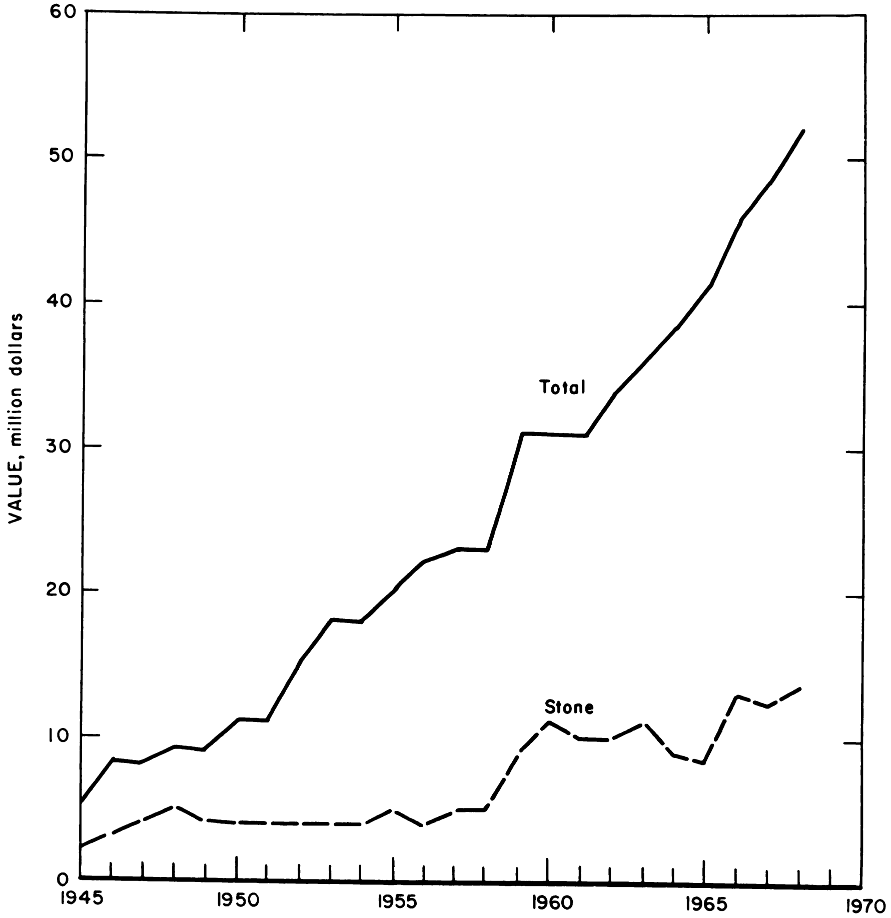

Figure 1.—Value of stone, and total value of mineral production in South Carolina.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Nonmetals and peat	1,004	250	251	2,008	-------	35	17.43	2,655
Sand and gravel	405	247	100	815	-------	15	18.39	423
Stone	841	268	225	1,870	1	42	23.00	3,582
Total	2,250	256	576	4,694	1	92	19.81	2,636
1968: p								
Nonmetals and peat	945	258	241	1,942	1	30	15.96	4,157
Sand and gravel	360	250	90	805	-------	16	19.86	504
Stone	775	260	202	1,665	-------	29	17.41	3,865
Total	2,080	256	532	4,413	1	75	17.22	3,191

p Preliminary.

also being mapped geologically during 1968. Other studies included the petrography and geophysics of the Rock Hill gabbro pluton in York County and a determination of radioactive mineral resources in South Carolina.

Reports published by the Division of Geology during 1968 were as follows: Bulletin 34, Geology and Mineral Resources of Oconee County; Bulletin 37, Geology and Mineral Resources of Little Mountain, South Carolina; and Geologic Notes, Volume 11, Number 4, and Volume 12, Numbers 1, 2, 3, and 4.

At yearend, 394 miles, or 52 percent, of the total Interstate Highway System designated for South Carolina was open to traffic. Work was in progress on 288 miles of highway and not yet started on 74 miles.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Portland cement shipments dropped 6 percent below the record set in 1967 but increased 1 percent in value. Masonry cement shipments increased 16 percent and value 27 percent, setting a new record in 1968. Out-of-State shipments of cement were to Florida, Georgia, North Carolina, and Virginia. The cement industry in South Carolina operated close to full capacity. Assuming the 1968 downturn is temporary, additional capacity may be necessary in the near future.

Clays.—Clay in 1968 accounted for 17 percent of the State's total mineral production value. Kaolin output increased from 540,435 tons valued at $6,970,471 in 1967 to record highs of 580,888 tons valued at $7,694,369 in 1968. The increased production was due mainly to increased demand for kaolin in rubber, fertilizer, brick, and other manufactured products. Exports of kaolin also increased. The State ranked second in the Nation in kaolin production. Twelve companies operated 21 mines in five counties during the year. New mines reporting in 1968 were the Yonce mine operated by Southeastern Clay Co., in Aiken County, and the Irby mine operated by Palmetto Brick Co., in Marlboro County.

Table 5.—Kaolin sold or used by producers, by uses

(Short tons)

Use	1967	1968
Rubber	261,974	272,155
Firebrick and block	10,291	37,333
Paint	W	6,535
Insecticides and fungicides	W	5,255
Other uses [1]	268,170	259,610
Total	540,435	580,888

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes whiteware, stoneware, floor and wall tile, architectural terracotta, mortar, foundries and steelworks, kiln furniture, other refractories, paper filling, paper coating, linoleum and oilcloth, fertilizers, plaster and plaster products, other fillers, exports, other uses and uses indicated by symbol W.

Production and value of miscellaneous clay increased 14 percent, but were respectively 18 percent and 14 percent below the records set in 1966. Increased production of miscellaneous clay was due to greater demand for building brick, which was the primary end use. The demand for specialty brick, predominantly those of darker color and simulated old brick, increased rapidly. Seventeen companies operated 22 surface mines in 15 counties during 1968. Four new mines were reported: The Tupelo mine in Newberry County, operated by Southern Brick Co.; the Lancaster mine in Lancaster County, operated by Yoder Farm; the Corley mine in Lexington County, operated by Guignard Brick Co.; and the Haskel mine in Richland County, operated by Carolina Ceramics, Inc.

Feldspar.—Feldspar production rose 5 percent and value increased 26 percent during the year, setting a new record. The feldspar was contained in a feldspar-silica mixture recovered from crushed granite fines. South Carolina ranked fifth among the States in feldspar production. However, the State has only one feldspar operation. The material was used out of State in the manufacture of pottery, glass, and rubber.

Kyanite.—South Carolina ranked third in the Nation in kyanite production. Output from the one mine in the State, in York County, dropped 8 percent, but value increased slightly. In 1968, production and value were respectively 23 percent and 6 percent lower than in the record year of

1964. All of the kyanite was used in manufacturing refractories.

Lime.—Regenerated or recirculated lime was produced by four companies in four counties. Production and value rose 8 percent to 341,114 tons and $3.5 million, respectively, setting new records in 1968.

Mica.—Scrap mica was produced from mica schist at one operation in Lancaster County. Production rose 19 percent and value 12 percent, owing to greater demand for use in pipeline enamel and paint manufacture. However, output and value were respectively 33 percent and 4 percent lower than the record set in 1955.

Pyrite.—Pyrite was recovered as a byproduct of kyanite milling at one operation in York County. In 1968, production and value rose 33 percent and 65 percent, respectively.

Sand and Gravel.—Sand and gravel was produced by 23 companies at 28 mines in 16 counties. Leading counties were Marlboro, Sumter, and Lexington, in that order. In 1968, production was 5.7 million tons valued at $8.1 million, increases of 8 percent and 12 percent, respectively, in tonnage and value over 1967. Increased production in 1968 was due mainly to increased demand for construction purposes. Seventy-six percent of sand was used for building purposes. All sand and gravel was commercial production, and 95 percent was processed before shipment. Fifty-three percent of production was hauled by truck and 47 percent by rail.

A continued growth trend is expected for the sand and gravel industry in South Carolina, but good deposits containing adequate percentages of gravel are becoming scarce. At some operations in 1968, excess sand was produced in the course of meeting demand for gravel.

Stone.—Total stone output accounted for 27 percent of the State's mineral production value in 1968. Crushed granite was produced by four companies at 11 quarries in eight counties. Leading counties in output were Pickens, Lexington, and Spartanburg. Output and value increased 10 percent and 13 percent, respectively, setting new records. Increased production of crushed granite was due mainly to increased demand for use as bituminous aggregate, dense graded road base stone, macadam aggregate, surface treatment aggregate, and concrete aggregate. Other uses included railroad ballast, fine aggregate, riprap, and jetty stone. Eight stationary and three portable plants were in operation during the year.

Eighty-eight percent of the crushed granite was transported by truck, and the remainder by rail. In 1968, Superior Stone Co. began operating the new Rock Hill quarry in York County.

Table 6.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967			1968		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	2,833	$1,857	$0.66	2,854	$1,874	$0.66
Fill	135	W	W	W	W	W
Blast	10	50	5.00	13	62	4.77
Other sands	504	W	W	871	2,296	2.64
Total sand	3,482	W	W	W	W	W
Gravel:						
Fill	-----	-------	------	5	4	.80
Other gravel	1,766	W	W	W	W	W
Total gravel	1,766	W	W	W	W	W
Total sand and gravel [1]	5,248	7,178	1.37	5,662	8,074	1.43

W Withheld to avoid disclosing individual company confidential data; included with "Total sand and gravel."

[1] Includes paving, glass, molding, fire or furnace, engine, filtration, chemical, filler, foundry, pottery, and other industrial sands; structural, paving, and railroad ballast gravel, and uses indicated by symbol W.

Table 7.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1967			1968		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Aiken	1	114	$114	1	W	W
Chesterfield	3	470	W	2	W	W
Dorchester	2	373	W	3	388	$329
Greenville	3	93	51	3	W	W
Horry	1	95	275	1	W	W
Jasper	1	123	W	1	W	W
Lancaster	1	320	W	1	W	W
Lexington	5	915	1,566	6	1,064	1,867
Marlboro	1	1,228	W	2	W	W
Richland	1	W	W	1	100	80
Spartanburg	1	W	W	1	49	49
Sumter	1	986	W	1	W	W
Other counties [1]	6	531	5,172	5	4,061	5,749
Total	27	5,248	7,178	28	5,662	8,074

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."

[1] Includes Cherokee, Florence, Kershaw, Marion, and Pickens (1967) Counties, and counties indicated by symbol W.

Dimension granite was produced by three companies at three quarries in Fairfield and Kershaw Counties. Output of dimension granite decreased 5 percent and value declined 9 percent below 1967 levels. The decline was attributed to decreased demand for rough monumental stone.

Crushed limestone was produced by four companies at four quarries in Dorchester, Cherokee, and Orangeburg Counties. All plants were of the stationary type. In 1968, production increased less than 1 percent to 2.95 million tons, setting a new record; value dropped 13 percent. Limestone production in the State is closely tied to cement manufacture and agriculture, which, combined, used 82 percent of the State's output. The aglime (agricultural limestone) portion of the industry is changing rapidly, with a growing demand for high-magnesium, dolomitic lime, and a declining use of high-calcium lime. Most of the aglime used in South Carolina is shipped from nearby States. Eighty-eight percent of the State's crushed limestone production is hauled by truck and 12 percent by rail.

Vermiculite.—Vermiculite production increased 12 percent and value 10 percent owing to expanded markets and increased demand. The State ranked second in the Nation in crude vermiculite output. Two companies produced crude vermiculite from a number of small surface mines located in Laurens and Spartanburg Counties. The vermiculite was expanded at two plants near Enoree in Laurens County and one plant near Traveler's Rest in Greenville County. The expanded vermiculite was used as concrete aggregate, as loose-fill insulation, and in agriculture.

METALS

Ferroalloys.—Ferrophosphorus was produced by Mobil Oil Corp., Charleston, as a byproduct of elemental phosphorus furnace operations. Ferrosilicon, ferrochromium, and ferrochromium silicon were produced by Pittsburgh Metallurgical Co., also located in Charleston.

Zirconium.—A grinding plant for the production of dry-milled and granular zircon for foundry, refractory, ceramic, and glass uses was operated by M & T Chemicals, Inc., near Andrews, Georgetown County.

MINERAL FUELS

Peat.—Reed-sedge peat was produced by one company near Bennetts Point in Colleton County. Output and value declined slightly in 1968 owing to wet weather conditions. Dry weather is necessary for efficient mining, transporting, and air drying the peat.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Giant Portland Cement Co	1500 Chestnut St. Philadelphia, Pa. 19102	Plant	Dorchester.
Santee Portland Cement Co	Holly Hill, S.C. 29059	do	Orangeburg.
Clay:			
Kaolin:			
Cyprus Mines Corp	Box 1201 Trenton, N.J. 08618	Open-pit mine	Aiken.
Dixie Clay Co	230 Park Ave. New York, N.Y. 10017	do	Do.
J. M. Huber Corp	630 Third Ave. New York, N.Y. 10017	2 open-pit mines	Do.
National Kaolin Products Co	Box 431 Aiken, S.C. 29801	Open pit-mine	Do.
Southeastern Clay Co	Box 1022 Aiken, S.C. 29801	6 open-pit mines	Do.
Miscellaneous:			
Broad River Brick Co	Box 681 Gaffney, S.C. 29340	Open-pit mine	Cherokee.
Columbia Brick & Tile Co	Box 3307 Columbia, S.C. 29203	do	Richland.
Giant Portland Cement Co	1500 Chestnut St. Philadelphia, Pa. 19102	do	Dorchester.
Guignard Brick Co	Box 568 Cayce, S.C. 29033	2 open-pit mines	Lexington.
Southern Brick Co	Box 208 Ninety Six, S.C. 29666	do	Greenwood and Newberry.
Feldspar, crude: Spartan Minerals Co	Pacolet, S.C. 29372	Plant	Spartanburg.
Kyanite: Commercialores, Inc	Box 156 Clover, S.C. 29710	Open-pit mine	York.
Lime, regenerated:			
Bowater Carolina Corp	Catawba, S.C. 29704	Plant	Do.
International Paper Co	Georgetown, S.C. 29440	do	Georgetown.
South Carolina Industries, Inc	Florence, S.C. 29501	do	Florence.
West Virginia Pulp & Paper Co	Box 5207 N. Charleston, S.C. 29406	do	Charleston.
Mica, scrap: The Mineral Mining Corp	Kershaw, S.C. 29067	Open-pit mine	Lancaster.
Peat: Ti-Ti Peat Humus Co., Inc	Box 425 Charleston, S.C. 29402	Bog	Colleton.
Pyrite: See Kyanite.			
Sand and gravel:			
Becker Sand & Gravel Co	Box 848 Cheraw, S.C. 29520	5 open-pit mines	Chesterfield, Dorchester, Marlboro, Sumter,
Columbia Silica Sand Co	Box 1519 Columbia, S.C. 29202	2 open-pit mines	Lexington.
Deerfield Sand & Mining Co., Inc	Box 578 Ridgeland, S.C. 29936	Open-pit mine	Jasper.
Foster Bros. Dixiana Sand Co	Box 5442 Columbia, S.C. 29205	do	Lexington.
Pennsylvania Glass Sand Corp	Gen. Operations Dept. Berkeley Springs, W. Va. 25424	do	Do.
Stone:			
Granite, crushed:			
Palmetto Quarries Co	Drawer 5185 Columbia, S.C. 29205	4 quarries	Fairfield, Greenwood, Richland.
Superior Stone Co	Box 2568 Raleigh, N.C. 27602	2 quarries	Fairfield and York.
Vulcan Materials Co	Drawer 8834 Greenville, S.C. 29604	4 quarries	Greenville, Pickens, Spartanburg.
Weston & Brooker Co	650 Knox-Abbott Ave. Cayce, S.C. 29033	Quarry	Lexington.
Granite, dimension:			
Comolli Granite Co	Box 898 Elberton, Ga. 30635	Quarry	Kershaw.
Kershaw Granite Co., Inc	Box 250 Elberton, Ga. 30635	do	Do.
Winnsboro Granite Co	Rion, S.C. 29132	do	Fairfield.
Limestone, crushed:			
Giant Portland Cement Co	1500 Chestnut St. Philadelphia, Pa. 19102	Quarry	Dorchester.
Ideal Cement Co	620 Ideal Cement Bldg. Denver, Colo. 80202	do	Do.
Santee Portland Cement Corp	Holly Hill, S.C. 29059	do	Orangeburg.
Vulcan Materials Co	Drawer 8834 Greenville, S.C. 29604	do	Cherokee.

Table 8.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Vermiculite:			
Crude:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, Mass. 02140	Several open-pit mines.	Laurens and Spartanburg.
Patterson Vermiculite Co	Route 1 Enoree, S.C. 29335	Open-pit mine	Laurens.
Exfoliated:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, Mass. 02140	2 expanding plants	Greenville and Laurens.
Patterson Vermiculite Co	Route 1 Enoree, S.C. 29335	Mill and expanding plant.	Laurens.

The Mineral Industry of South Dakota

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the South Dakota State Geological Survey for collecting information on all minerals except fuels.

By M. Clair Smith[1] and William C. Henkes[2]

The value of mineral production in 1968 totaled $54.1 million and exceeded that of any year since 1964. The $1.5 million increase over 1967 can be attributed almost entirely to the gain in output of cement and to the increase in the value of the gold produced. The overall value of metals output increased, but the value of nonmetals and mineral fuels production decreased.

South Dakota retained its position as the leading gold producing State of the Nation.

Table 1.—Mineral production in South Dakota[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Beryllium concentrate ____ short tons	W	W	75	$35
Cement:				
Masonry ____ thousand 280-pound barrels	54	$178	54	180
Portland ____ thousand 376-pound barrels	1,406	4,815	1,826	6,228
Clays ____ thousand short tons	199	799	226	1,119
Coal (lignite) ____ do	5	27	----------	----------
Feldspar ____ long tons	61,411	420	39,077	264
Gem stones	NA	30	NA	34
Gold (recoverable content of ores, etc.) ____ troy ounces	601,785	21,062	593,052	[2] 23,283
Gypsum ____ thousand short tons	12	49	16	65
Petroleum (crude) ____ thousand 42-gallon barrels	211	502	187	401
Sand and gravel ____ thousand short tons	13,463	13,737	11,558	11,578
Silver (recoverable content of ores, etc.) thousand troy ounces	121	188	138	295
Stone ____ thousand short tons	1,866	9,694	1,860	9,687
Value of items that cannot be disclosed: Columbium-tantalum (1967), lime, lithium minerals, mica (scrap), molybdenum (1967), uranium[3] (recoverable content U_3O_8), vanadium, and value indicated by symbol W	XX	1,117	XX	917
Total	XX	52,618	XX	54,086
Total 1957–59 constant dollars	XX	[r] 47,308	XX	[p] 44,273

[p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Based on average of U.S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968, and the New York selling price for the remainder of the year.

[3] 1967 value estimated, based on $8.00 per pound f.o.b. mill; 1968 value estimated, based on $8.00 per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 per pound for commercial sales.

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[1] Mining engineer, Bureau of Mines, Denver, Colo.

[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 2.—Value of mineral production in South Dakota, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Aurora	$69	$97	Sand and gravel.
Beadle	145	126	Do.
Bon Homme	232	185	Do.
Brookings	753	101	Do.
Brown	576	346	Do.
Brule	274	140	Do.
Buffalo	27	20	Do.
Butte	W	W	Clays and sand and gravel.
Campbell	222	83	Sand and gravel.
Charles Mix	113	206	Sand and gravel and stone.
Clark	320	223	Sand and gravel.
Clay	64	99	Do.
Codington	808	W	Sand and gravel and stone.
Corson	153	55	Sand and gravel.
Custer	672	437	Feldspar, sand and gravel, stone, petroleum, lime, beryllium concentrate, gold.
Davison	424	268	Sand and gravel.
Day	495	179	Do.
Deuel	105	117	Do.
Dewey	37	W	Sand and gravel and coal.
Douglas	278	225	Sand and gravel.
Edmunds	92	122	Do.
Fall River	W	W	Sand and gravel, uranium, stone.
Faulk	152	148	Sand and gravel.
Grant	6,335	6,639	Stone and sand and gravel.
Gregory	104	119	Sand and gravel.
Haakon	41	143	Do.
Hamlin	276	178	Do.
Hand	231	185	Do.
Hanson	702	W	Stone and sand and gravel.
Harding	W	482	Petroleum and sand and gravel.
Hughes	127	132	Sand and gravel.
Hutchinson	176	251	Do.
Hyde	68	92	Do.
Jackson	322	817	Do.
Jerauld	21	37	Do.
Jones	189	41	Do.
Kingsbury	127	102	Do.
Lake	88	147	Do.
Lawrence	22,348	23,725	Gold, silver, stone, sand and gravel.
Lincoln	81	166	Sand and gravel.
Lyman	62	307	Do.
Marshall	103	198	Do.
McCook	160	64	Do.
McPherson	98	128	Do.
Meade	287	369	Sand and gravel and gypsum.
Mellette	437	229	Sand and gravel.
Minnehaha	1,037	1,245	Stone and sand and gravel.
Moody	593	398	Sand and gravel.
Pennington	8,150	10,625	Cement, stone, sand and gravel, lime, clays, mica (scrap), feldspar, beryllium concentrate, lithium minerals.
Perkins	39	101	Sand and gravel.
Potter	305	196	Do.
Roberts	293	87	Do.
Sanborn	203	61	Do.
Shannon	2	64	Do.
Spink	149	89	Do.
Stanley	73	W	Do.
Sully	122	79	Do.
Todd	34	115	Do.
Tripp	W	94	Stone and sand and gravel.
Turner	123	174	Sand and gravel.
Union	341	53	Do.
Walworth	115	W	Do.
Washabaugh	31	111	Do.
Yankton	189	18	Do.
Ziebach	133	68	Do.
Undistributed[2]	2,291	2,785	
Total[3]	52,618	54,086	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Bennett and Miner Counties not listed because no production was reported.

[2] Includes production of gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of South Dakota business activity

		1967	1968 [p]	Change (percent)
Employment and labor force, mid-June:				
Total labor force	thousands	284.1	289.2	+1.8
Total employment	do	273.3	278.6	+1.9
Total unemployment	do	10.8	10.6	—1.9
Total agricultural employment	do	74.0	74.6	+.8
Total non-agricultural employment	do	199.3	204.0	+2.4
Mining	do	2.4	2.3	—4.2
Contract construction	do	8.9	10.5	+18.0
Manufacturing	do	15.3	15.7	+2.6
Trade	do	44.3	45.1	+1.8
Government	do	49.4	50.6	+2.4
All other	do	79.0	79.8	+1.0
Personal income:				
Total	millions	[r] $1,745	$1,913	+9.6
Per capita		[r] $2,613	$2,916	+11.6
Construction activity:				
Cement shipments to and within the State	thousand 376-pound barrels	1,237	1,560	+26.1
Building permits	thousands	NA	$41,994	--------
Residential	do	NA	$14,695	--------
Non-residential	do	NA	$27,299	--------
Road construction contracts	do	$48,299	$32,120	—33.5
Farm cash income	millions	$990.0	$1,049.3	+6.0
Mineral production	do	$52.6	$54.1	+2.9
Total State revenue (fiscal 1966–67 and fiscal 1967–68)	do	$202.0	$220.6	+9.2

[p] Preliminary. [r] Revised. NA Not available.

Sources: Business Research Bureau, University of South Dakota, Vermillion, S. Dak.; Engineering News-Record, v. 182, No. 14, Apr. 3, 1969, pp. 52–53.

On March 18, 1968 the Government made two major changes that affected the gold market. First, the Treasury ceased buying and selling gold in the private market; second, gold producers were allowed to sell their gold to foreign buyers, as well as to authorized domestic users.

The price of gold was $35.00 per fine troy ounce from 1934 to March 18, 1968. However, during the remainder of 1968, the price varied between $42.21 and $37.75. The Metals Week weekly average for the year was $39.97 per fine troy ounce.

Employment and Injuries.—The extent of employment and injuries in the mineral industry, exclusive of the petroleum industry, is presented in table 4.

Government Programs.—Diamond drilling, supervised by the U.S. Geological Survey, was conducted in the northern Black Hills to determine the thickness and mineralogy of the Paleozoic Formations. Mapping and some drilling were done south of Lead to obtain information on the stratigraphy of the rocks containing the Homestake gold deposits.

Exploration work on silver ore bodies near Galena was recessed in the fall. The work was contracted by Homestake Mining Co. and supervised by the U.S. Geological Survey.

Contracts were awarded in 1968 totaling $32.1 million for highway construction of which $20.4 million was for the interstate system.[3]

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[3] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1969 . . . and Budgets for Maintenance: Highway Award Plans Up 47% as '69 Federal-Aid Work Soars. V. 182, No. 14, Apr. 3, 1969, pp. 52–53.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	5	108	1	4	-------	-------	-------	-------
Metal	1,695	311	528	4,222	-------	114	27.00	2,729
Nonmetal	266	232	62	518	-------	6	11.71	43
Sand and gravel	977	154	150	1,359	-------	25	18.40	445
Stone	463	227	105	894	-------	15	16.78	302
Total [1]	3,406	248	846	6,991	-------	160	22.88	1,776
1968: [p]								
Coal	5	107	1	4	-------	-------	-------	-------
Metal	1,605	302	494	3,953	2	114	29.34	4,132
Nonmetal	215	191	41	330	1	7	24.22	18,846
Sand and gravel	735	158	116	1,049	-------	23	21.93	730
Stone	470	231	109	919	-------	14	15.23	283
Total [1]	3,030	248	761	6,256	3	158	25.73	3,770

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

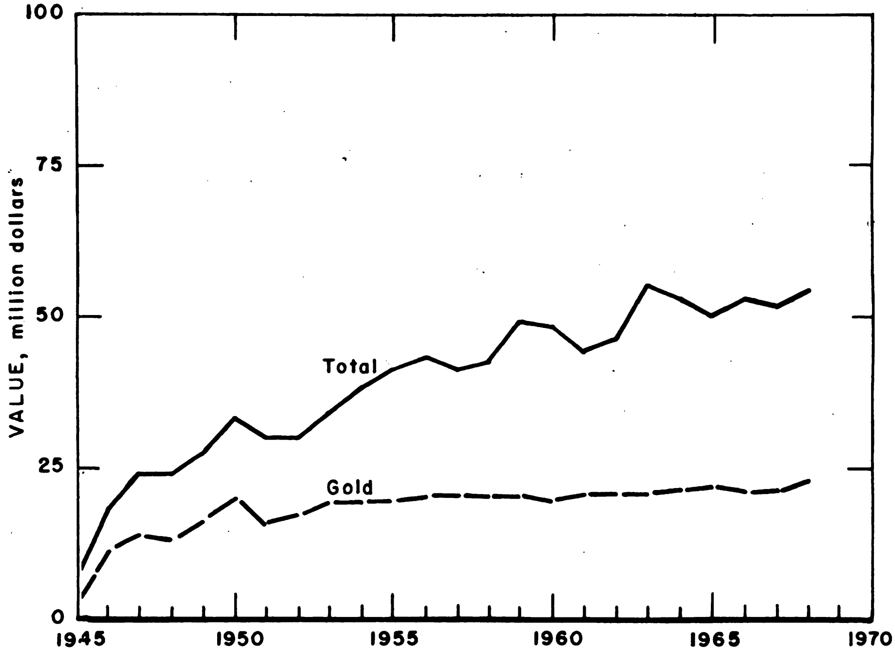

Figure 1.—Value of mine production of gold, and total value of mineral production in South Dakota.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—The State-owned cement plant at Rapid City shipped 54,000 barrels (280-pound) of masonry cement, the same amount shipped in 1967. Shipments of portland cement increased 420,000 barrels (376-pound) over those of 1967. The 1968 cement production required 371,735 short tons of limestone, 102,761 tons of shale, 15,618 tons of gypsum, 10,617 tons of sand, and 4,816 tons of iron ore. The aggregate of the minerals used in cement output was produced in South Dakota.

The air-pollution filters installed during 1967 and 1968 in kiln stacks have been very effective in removing micron-size particles from the gases emitted to the atmosphere. The South Dakota Cement Commission has set a good example of air-pollution control for cement and other industries.

Clays.—Bentonite and miscellaneous clay were produced in Butte County. Shale was mined in Pennington County, where it is used in manufacturing cement and also expanded to make a lightweight concrete aggregate. The bentonite was produced by American Colloid Co. and by International Minerals & Chemical Corp. (IMC).

The plant of American Colloid Co. at Belle Fourche was the only bentonite processing plant operated in South Dakota. Bentonite mined by IMC in South Dakota was processed at the company plant in Colony, Wyo.

Brick kilns at Belle Fourche, operated by Black Hills Clay Products Co., produced building brick marketed in the surrounding area.

Feldspar.—Feldspar was obtained from numerous pegmatites located in the vicinity of Custer and Keystone. IMC operated a dry grinding plant at Custer, which ground feldspar obtained from company-operated mines and from various local producers operating their own or leased properties.

Gypsum.—Gypsum produced by the State at a quarry in Meade County was used in manufacturing cement. This was the only gypsum operation. An increase in production was necessary because cement manufacture was greater.

Lime.—The demand for lime has increased because of its use as a soil stabilizing agent in road construction wherever clay soils exist. Pete Lien & Sons operated a horizontal and a vertical kiln at the company plant northwest of Rapid City.

Operated by Sam Kirk, Black Hills Lime Co. at Pringle specializes in producing metallurgical lime. Its demand depends greatly upon the activity of mineral processing plants, such as Homestake Mining Co. at Lead and Mines Development, Inc., a subsidiary of The Susquehanna Corp., at Edgemont.

Lithium Minerals.—Lithium minerals were obtained as a coproduct in pegmatite mining. They are stockpiled by the producer or purchased by local mineral brokers until a carlot shipment has accumulated. Two lithium minerals—lepidolite and amblygonite—were obtained and shipped in separate lots.

Mica.—Scrap mica was one of the products recovered at the flotation mill near Keystone, operated by Northwest Beryllium Corp. Production increased 300 percent over that in 1967.

Sand and Gravel.—Sand and gravel production in 1968 was nearly 2 million tons less than that of 1967; value decreased more than $2 million. The 1968 production, used mainly in building and maintenance of highways, was 11.6 million tons valued at $11.6 million.

Stone.—Granite and limestone were the only types of stone prepared and sold as dimension stone. Limestone, sandstone, and quartzite, and miscellaneous stone were crushed and used; most of the crushed stone was used as concrete aggregate and road material.

A very good grade of granite was quarried by five companies operating seven quarries in Grant County; 26,500 tons was sawed into desired dimensions and polished for use as decorative stone or as monuments, and 11,900 tons was sold as rough architectural and monumental stone.

With quarries in the Dakota Sandstone Formation near Pringle and a plant at Pringle, South Dakota Sand Corp., a subsidiary of Texas Mining Corp., produced three types of prepared or manufactured sands: Oil-well fracturing sands, foundry sands, and abrasive sands used in sand blasting.

Table 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand, construction:				
Building	621	$677	456	$498
Paving	56	56	113	139
Fill	43	21	58	65
Total	720	754	627	702
Gravel:				
Construction:				
Building	472	672	220	319
Paving	1,384	1,596	1,795	1,803
Railroad ballast	4	3	--------	--------
Fill	78	64	139	110
Other	1	1	--------	--------
Miscellaneous	31	37	43	54
Total	1,970	2,373	2,197	2,286
Total sand and gravel	2,690	3,127	2,824	2,988
Government-and-contractor operations:				
Sand:				
Building	--------	--------	1	1
Paving	1,967	1,964	1,738	1,736
Fill	11	11	1	1
Other	10	5	11	6
Total	1,988	1,980	1,751	1,744
Gravel:				
Paving	8,774	8,620	6,983	6,847
Fill	10	9	--------	--------
Other	1	1	--------	--------
Total	8,785	8,630	6,983	6,847
Total sand and gravel [1]	10,773	10,616	8,734	8,587
All operations:				
Sand	2,708	2,734	2,378	2,446
Gravel	10,755	11,003	9,180	9,133
Total [1]	13,463	13,737	11,558	11,578

[1] Data may not add to totals shown because of independent rounding.

Table 6.—Sand and gravel production in 1968, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Aurora	92	$97	Jerauld	37	$37
Beadle	126	126	Jones	53	41
Bon Homme	184	185	Kingsbury	102	102
Brookings	83	101	Lake	145	147
Brown	315	346	Lawrence	W	W
Brule	137	140	Lincoln	152	166
Buffalo	24	20	Lyman	312	307
Butte	367	368	McCook	63	64
Campbell	100	83	McPherson	125	128
Charles Mix	200	200	Marshall	188	198
Clark	223	223	Meade	303	304
Clay	88	99	Mellette	229	229
Codington	300	315	Minnehaha	548	558
Corson	94	55	Moody	373	398
Custer	90	86	Pennington	1,689	1,526
Davison	240	263	Perkins	79	101
Day	163	179	Potter	187	196
Deuel	107	117	Roberts	80	87
Dewey	54	43	Sanborn	59	61
Douglas	205	225	Shannon	66	64
Edmunds	113	122	Spink	88	89
Fall River	206	160	Stanley	W	W
Faulk	148	148	Sully	79	79
Grant	113	120	Todd	120	115
Gregory	104	119	Tripp	39	39
Haakon	143	143	Turner	159	174
Hamlin	152	178	Union	53	53
Hand	216	185	Walworth	W	W
Hanson	82	82	Washabaugh	111	111
Harding	107	107	Yankton	18	18
Hughes	143	132	Ziebach	68	68
Hutchinson	251	251	Undistributed	154	191
Hyde	92	92			
Jackson	817	817	Total	11,558	11,578

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Table 7.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Kind of stone	1964		1965		1966		1967		1968	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Dolomite	-----	-----	-----	-----	-----	-----	(1)	$1	-----	-----
Granite	18	$2,808	20	$2,945	24	$4,067	48	6,160	38	$6,519
Limestone	1,180	1,735	869	1,412	1,101	1,793	[2] 882	[2] 1,399	[2] 1,082	[2] 1,694
Quartz, quartzite, and sandstone	920	1,702	651	1,007	984	1,997	[2] 781	[2] 1,623	676	1,402
Quartz and quartzite	NA	NA	NA	NA	NA	NA	NA	NA	563	1,193
Sandstone	NA	NA	NA	NA	NA	NA	NA	NA	113	209
Other stone	-----	-----	14	24	78	137	155	512	64	71
Total [3]	2,118	6,245	1,554	5,387	2,186	7,995	1,866	9,694	1,860	9,687

NA Not available.

[1] Less than ½ unit.

[2] Excludes dimension stone, included with "Other stone."

[3] Data may not add to totals shown because of independent rounding.

Table 8.—Stone sold or used by producers, by uses

Use	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension stone:				
Rough construction and rubble..short tons..	W	W	11,986	W
Rough architectural..........cubic feet.. Dressed architectural..........do.... Rough monumental..........do....	[1] 181,680	[1] $3,115	[1] 205,685	W
Dressed monumental..........do....	147,386	3,008	151,852	$3,269
Curbing and flagging..........do....	W	W	W	W
Total (approximate)..........short tons..	31,200	6,130	47,400	6,535
Crushed and broken stone:				
Refractory..........short tons..	38,750	78	W	W
Riprap..........do....	184,547	548	76,779	81
Railroad ballast..........do....	345,066	487	286,245	435
Concrete and roadstone..........do....	834,946	1,480	(2)	(2)
Concrete aggregate..........do....	NA	NA	335,447	785
Cement..........do....	352,519	617	388,911	W
Other..........do....	[3] 79,417	[3] 353	[4] 694,891	[4] 1,117
Total..........do....	1,835,245	3,564	1,812,273	3,152
Total stone (approximate)..........do....	1,866,500	9,694	1,859,700	9,687

NA Not available. W Withheld to avoid disclosing individual company confidential data; included in "Totals."

[1] Rough architectural (1967), dressed architectural, and rough monumental combined to avoid disclosing individual company confidential data.

[2] Concrete and roadstone subdivided in 1968 into concrete aggregate and various aggregates used for road construction. Data for aggregates used for road construction withheld to avoid disclosing individual company confidential data; included with "Other."

[3] Includes stone used for abrasives, architectural panels, foundry, lime, filler, precasting, and stone sand.

[4] Includes stone used for abrasives, agricultural limestone, bituminous aggregate, dense graded road base, flux, lime, other fillers, stone sand, surface treatment aggregates, and terrazzo and exposed aggregate.

METALS

Beryllium.—Beryllium shipments were substantially greater than those in 1967. George Bland produced hand-cobbed beryl from properties which he operated and also purchased small lots from other producers. Most of the Black Hills production was sold to Beryl Ores Co. at Arvada, Colo. Northwest Beryllium Corp. produced some hand-cobbed beryl, but it did not operate the beryl section of its flotation mill during 1968.

Gold and Silver.—Gold was produced by Homestake Mining Co. from its lode mine at Lead. Two placer operations—one on Whitewood Creek in Lawrence County, the other in Custer County—reported some gold recovery at their operations. The Homestake mine, with deepest workings 6,800 feet below the surface, produced gold and silver valued at $23.5 million, nearly half of the total State mineral production value of $54.1 million.

Table 9.—Mine production of gold and silver in terms of recoverable metals

Year	Mines producing		Material sold or treated [1] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Thousand troy ounces	Value (thousands)
1964..........	3	1	2,033	616,913	$21,592	133	$172
1965..........	1	....	2,032	628,259	21,989	129	167
1966..........	1	....	2,002	606,467	21,226	110	142
1967..........	1	1	1,896	601,785	21,062	121	188
1968..........	1	2	1,922	593,052	23,283	138	295
1876–1968...	NA	NA	NA	33,009,196	939,445	12,507	9,911

NA Not available.

[1] Excludes placer gravel.

Table 10.—Homestake mine ore milled and receipts for bullion[1]

Year	Ore milled (thousand short tons)	Receipts for bullion products	
		Total (thousands)	Per ton
1964	2,033	$21,703	$10.68
1965	2,032	22,094	10.88
1966	2,002	21,309	10.64
1967	1,896	21,200	11.18
1968	1,922	22,064	11.48

[1] From 1876 to 1968, inclusive, this mine yielded bullion and concentrates that brought a net return of $867.8 million.
In previous years a column reflecting "dividends" was included. It has been omitted this year because this table is for the Homestake mine only, and the dividends pertain to the consolidated operations of Homestake Mining Co. and subsidiaries.

Homestake and the United Steelworkers of America, AFL–CIO, have a supplemental agreement which allows the workers a pay increase on a sliding scale, based on the "buy" price of gold as quoted by Engelhard Minerals & Chemicals Corp. of New York City. The wage bonus starts at 7 cents per hour with gold at $36.00 per fine troy ounce and increases to 85 cents per hour with gold "buy" price at $49.00 per fine troy ounce.

Tin.—In 1968 some tin concentrate, obtained as a byproduct from pegmatite milling, was stockpiled by Northwest Beryllium Corp.

Uranium.—Uranium output from eight operators was less than half of that produced in 1967. Susquehanna-Western, Inc., a subsidiary of The Susquehanna Corp., did a large amount of rotary drilling in the Edgemont area, and at yearend it was encouraged by the ore bodies found. Mines Development, Inc., was very optimistic about expanding production at its uranium mill at Edgemont on the basis of these new finds.

Vanadium.—Production was obtained from local uranium ores and domestic vanadium-bearing residues.

MINERAL FUELS

Coal (Lignite).—Only one commercial coal mine, operated by Firesteel Coal Co. in Dewey County, produced lignite coal in 1968.

Petroleum.—Normal depletion of the two oilfields—Buffalo and Barker Dome—resulted in an 11.5-percent decrease in output of petroleum. The 24-well Buffalo field produced 174,614 barrels of oil; Barker Dome, with three wells, yielded 12,041 barrels. Buffalo field also produced 10.7 million cubic feet of natural gas, which was used for field fuel or flared.

Drilling activity, all exploratory, more than doubled, chiefly because of the interest in the Muddy Formation (Cretaceous) in adjacent parts of Wyoming and Montana. In Fall River County, 13 wildcat wells tested the Muddy Formation along the southern flank of the Black Hills uplift. Ten wells were drilled north of the Black Hills: Two were tests of the Red River Formation (Ordovician); the others tested the Muddy.

Table 11.—Oil and gas well drilling in 1968, by counties[1]

County	Dry[2]	Total	Footage
Butte	4	4	11,951
Fall River	13	13	31,866
Harding	6	6	32,950
Total	23	23	76,767

[1] Exploratory completions; no development wells were drilled during the year.
[2] All exploratory wells were unsuccessful.
Source: Petroleum Information Corp., 1968 Résumé, Oil and Gas Operations in the Rocky Mountain Region.

Two oil and gas lease sales were held by the State. The first, on June 12–15, totaled 695,797 acres resulting in an income of $843,911. The average amount received was $1.213 per acre; the high bid was $9.38 per acre for a lease in Harding County. Because of the proximity of Montana's Bell Creek field, most of the acreage leased was in Harding County; this land brought the highest per-acre bid, $2.14. The second sale, held December 18, covered 153,939 acres and brought total receipts of $104,934, an average of $0.68 per acre. For the latter, most of the land leased was in Perkins County, where the highest bid was $2.81 per acre.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Beryllium:			
L.W. Judson	Hermosa, S. Dak. 57744	See Feldspar	Pennington.
Northwest Beryllium Corp.	218–219 American National Bank Bldg. Rapid City, S. Dak. 57701	Open-pit mine	Do.
Cement: South Dakota Cement Commission.	Drawer 351 Rapid City, S. Dak. 57701	Wet-process, 3-rotary-kiln plant.	Do.
Clays:			
American Colloid Co.	5100 Suffield Court Skokie, Ill. 60076	Open-pit mine and plant.	Butte.
Light Aggregates, Inc.	Box 1922 Rapid City, S. Dak. 57701	do	Pennington.
South Dakota Cement Commission.	Drawer 351 Rapid City, S. Dak. 57701	Open-pit mine	Do.
Coal (lignite): Firesteel Coal Co.	Timber Lake, S. Dak. 57656	Strip mine, crushing and oil-treatment plant.	Dewey.
Feldspar:			
International Minerals & Chemical Corp., Industrial Minerals Division.	Administration Center Old Orchard Road Skokie, Ill. 60079	2 open-pit mines and dry-grinding plant.	Custer.
L.W. Judson	Hermosa, S. Dak. 57744	Open-pit mine	Pennington.
Northwest Beryllium Corp.	218–219 American National Bank Bldg. Rapid City, S. Dak. 57701	Underground mine and flotation mill.	Do.
Gold: Homestake Mining Co.	Lead, S. Dak. 57754	Underground mine, amalgamation-cyanidation mill, and refinery.	Lawrence.
Gypsum: South Dakota Cement Commission.	Drawer 351 Rapid City, S. Dak. 57701	Open pit mine	Meade.
Lime: Pete Lien & Sons	Box 3124, P.O. Annex Rapid City, S. Dak. 57703	1-rotary-kiln, 1-vertical-kiln, continuous-hydrator plant.	Pennington.
Mica (scrap):			
L.W. Judson	Hermosa, S. Dak. 57744	See Feldspar	Do.
Northwest Beryllium Corp.	218–219 American National Bank Bldg. Rapid City, S. Dak. 57701	do	Do.
Petroleum:			
The Ozark Corp.	Box 2491 Casper, Wyo. 82601	Crude oil wells	Custer (Barker Dome field).
Pennzoil Co.	900 Southwest Tower Houston, Tex. 77002	do	Harding (Buffalo field).
Phillips Petroleum Co.	Phillips Bldg. Bartlesville, Okla. 74003	do	Do.
Sand and gravel (commercial):			
Aggregates, Inc.	Selby, S. Dak. 57472	Pit	Fall River.
		Pit and plant	Pennington.
Clark Construction Co.	Mitchell S. Dak. 57301	do	Davison.
Concrete Materials Co.	3000 West Madison Street Sioux Falls. S. Dak. 57104	do	Minnehaha.
Hallett Construction Co.	Crosby, Minn. 56441	do	Codington.
Moeckly & Olson, Inc.	Amherst, S. Dak. 57421	Pit	Edmunds.
		do	Potter.
		5 pits and plant	Walworth.
Silver: Homestake Mining Co.	Lead, S. Dak. 57754	See Gold	Lawrence.
Stone:			
Cold Spring Granite Co.	Cold Spring, Minn. 56320	2 quarries and plant	Grant.
Concrete Materials Co.	3000 West Madison Street Sioux Falls, S. Dak. 57104	Quarry and plant	Minnehaha.
Dakota Granite Co.	Box 269 Milbank, S. Dak. 57252	2 quarries and plant	Grant.
Hills Material Co.	Box 1392 Rapid City, S. Dak. 57701	Quarry and plant	Pennington.
L. G. Everist, Inc.	302 Paulton Bldg. Sioux Falls, S. Dak. 57102	do	Minnehaha.
		do	Pennington.
Pete Lien & Sons	Box 3124, P.O. Annex Rapid City, S. Dak. 57703	do	Pennington.
Robert Hunter Granite Co.	Millbank, S. Dak. 57252	do	Grant.
South Dakota Cement Commission.	Drawer 351 Rapid City, S. Dak. 57701	do	Do.
Spencer Quarries, Inc.	Spencer, S. Dak. 57374	do	Hanson.
Uranium:			
Susquehanna-Western, Inc.	Edgemont, S. Dak. 57735	1 open-pit-underground, 1 open-pit, and 3 underground mines.	Fall River.
Mines, Development, Inc.	do	Acid-leach mill	Do.
Vanadium: Susquehanna-Western, Inc.	do	Vanadium-recovery plant.	Do.

The Mineral Industry of Tennessee

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Tennessee Division of Geology, for collecting information on all minerals except fuels.

By Doss H. White, Jr. [1] and Robert E. Hershey [2]

In 1968, Tennessee's mineral production was valued at $201 million, an increase of 6 percent over that of 1967. Increases in production were noted in most mineral commodities directly related to the Nation's economic growth, while some specialty and byproduct commodities decreased.

Most sectors of the State's economy showed increases, however, industrial investments and employment were below the 1967 levels. Freight traffic on the Tennessee River increased for the seventh consecutive year, with 73 percent of the traffic either originating or terminating outside of the Valley area. New records were set in the shipment of chemicals, coal and coke, forest products, iron and steel products, and petroleum products.

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[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.

[2] State geologist, Division of Geology, Department of Conservation, Nashville, Tenn.

Table 1.—Mineral production in Tennessee[1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Barite……short tons	14,862	$235	20,964	$362
Cement:				
Portland……thousand 376-pound barrels	8,062	25,548	8,488	27,691
Masonry……thousand 280-pound barrels	1,092	2,992	1,370	3,836
Clays [2]……thousand short tons	1,574	5,152	1,562	5,772
Coal (bituminous)……do	6,832	26,974	8,148	29,647
Copper (recoverable content of ores, etc.)……short tons	14,600	11,162	14,196	11,881
Gold (recoverable content of ores, etc.)……troy ounces	181	6	140	[3] 5
Natural gas……million cubic feet	58	11	48	9
Petroleum (crude)……thousand 42-gallon barrels	7	W	6	W
Phosphate rock……thousand short tons	2,992	22,571	3,149	23,628
Sand and gravel……do	7,975	10,679	7,344	11,140
Silver (recoverable content of ores, etc.) thousand troy ounces	130	202	90	192
Stone [4]……thousand short tons	31,463	41,958	32,083	43,854
Zinc (recoverable content of ores, etc.)……short tons	113,065	31,303	124,039	33,491
Value of items that cannot be disclosed: Clay (fuller's earth), lime, pyrite, stone (crushed sandstone), and values indicated by symbol W	XX	10,779	XX	9,826
Total	XX	189,572	XX	201,334
Total 1957–59 constant dollars	XX	[r] 176,097	XX	[p] 181,707

[p] Preliminary. [r] Revised. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fuller's earth; included with "Value of items that cannot be disclosed."

[3] Based on average U.S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968, and the New York selling price for the remainder of the year.

[4] Excludes crushed sandstone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Tennessee, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Anderson	W	$7,911	Coal, limestone.
Bedford	W	W	Limestone.
Benton	W	1,978	Sand and gravel, limestone.
Bledsoe	$107	W	Coal.
Blount	W	W	Limestone, marble.
Bradley	W	368	Limestone.
Campbell	W	7,358	Coal, limestone, sandstone.
Cannon	W	W	Limestone.
Carroll	W	W	Sand and gravel.
Carter	W	W	Limestone.
Claiborne	W	5,341	Coal, limestone.
Clay	W	W	Limestone.
Cocke	W	W	Do.
Coffee	W	W	Do.
Cumberland	W	2,005	Limestone, sandstone, sand and gravel, coal.
Davidson	13,679	11,679	Cement, limestone, sand and gravel, phosphate rock, miscellaneous clay.
Decatur	W	W	Limestone, sand and gravel.
De Kalb	W	W	Limestone.
Dickson	-------	W	Do.
Fayette	77	79	Sand and gravel.
Fentress	384	546	Coal, limestone, sandstone.
Franklin	5,237	6,572	Cement, limestone, sand and gravel, miscellaneous clay.
Gibson	W	W	Sand and gravel.
Giles	W	W	Phosphate rock, limestone, sand and gravel.
Grainer	W	W	Limestone, marble.
Greene	W	W	Limestone, sand and gravel.
Grundy	W	953	Coal, sand and gravel, limestone.
Hamblen	W	W	Limestone.
Hamilton	9,269	10,777	Cement, limestone, sand and gravel, coal, miscellaneous clay.
Hancock	W	W	Zinc, limestone.
Hardeman	W	W	Sand and gravel.
Hardin	W	W	Limestone, sand and gravel.
Hawkins	W	W	Limestone.
Haywood	61	78	Sand and gravel.
Henderson	W	W	Do.
Henry	W	3,261	Ball clay, fuller's earth.
Hickman	557	W	Phosphate rock.
Humphreys	W	W	Limestone, sand and gravel.
Jefferson	24,225	25,531	Zinc, limestone.
Johnson	W	W	Limestone.
Knox	16,435	18,250	Cement, zinc, limestone, lime, sand and gravel, marble, miscellaneous clay.
Lauderdale	107	109	Sand and gravel.
Lincoln	W	W	Limestone.
Loudon	522	664	Limestone, marble, miscellaneous clay, barite, sand and gravel.
Macon	W	W	Limestone.
Marion	W	9,276	Coal, cement, limestone.
Marshall	W	W	Limestone.
Maury	W	14,519	Phosphate rock, limestone.
McMinn	W	961	Limestone, barite, sand and gravel.
McNairy	W	W	Sand and gravel.
Meigs	W	W	Limestone.
Monroe	W	268	Limestone, sand and gravel, barite.
Montgomery	W	W	Limestone.
Morgan	1,351	1,445	Coal.
Obion	W	345	Sand and gravel.
Overton	W	224	Coal, limestone.
Pickett	62	2	Limestone.
Polk	W	W	Copper, pyrites, zinc, silver, sand and gravel, gold.
Putnam	W	1,054	Limestone, coal, sand and gravel.
Rhea	220	205	Limestone, coal.
Roane	W	W	Limestone.
Robertson	W	W	Do.
Rutherford	1,203	1,024	Do.
Scott	1,775	2,544	Coal.
Sequatchie	W	1,214	Coal, limestone.
Sevier	W	742	Limestone, sand and gravel.
Shelby	W	792	Sand and gravel, miscellaneous clay.
Smith	149	94	Limestone.
Stewart	W	W	Limestone, sand and gravel.
Sullivan	W	W	Cement, limestone, miscellaneous clay.
Sumner	W	1,944	Limestone, phosphate rock.

See footnotes at end of table.

Table 2.—Value of mineral production in Tennessee, by counties [1]—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Tipton	W	W	Sand and gravel.
Unicoi	W	W	Sand and gravel, limestone.
Union	W	W	Marble, limestone.
Van Buren	$1,255	$980	Coal.
Warren	W	W	Limestone.
Washington	W	637	Limestone, sand and gravel, miscellaneous clay.
Wayne	W	W	Sand and gravel, limestone.
Weakley	2,227	2,392	Ball clay, miscellaneous clay.
White	W	W	Limestone.
Williamson	W	W	Phosphate rock, limestone.
Wilson	W	W	Limestone.
Undistributed [2]	110,671	57,217	
Total [3]	189,572	201,334	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Cheatham, Chester, Crockett Dyer, Houston, Jackson, Lake, Madison, Moore, Perry, and Trousdale.

[2] Includes value of petroleum, natural gas, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

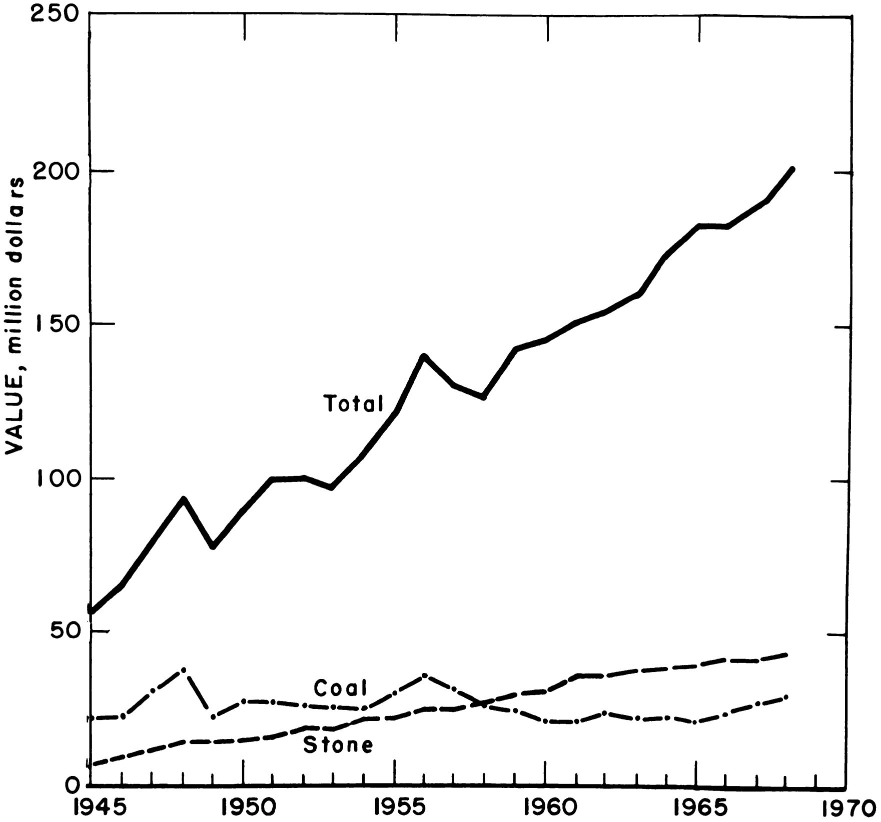

Figure 1.—Value of stone, coal, and total value of mineral production in Tennessee.

Table 3.—Selected indicators of Tennessee business activity

	1967	1968	Change (percent)
Employment (average):			
Total nonagricultural .... thousands..	[r] 1,217.4	1,239.2	+1.7
Manufacturing .... do....	[r] 434.9	444.5	+2.2
Personal income:			
Total .... millions..	[r] $9,316	$10,147	+8.9
Per capita	[r] $2,367	$2,553	+7.8
Construction activity:			
Housing units authorized	20,971	25,546	+21.8
Value of construction .... millions..	$198	$266	+34.3
Industrial growth:			
Number of units	374	400	+7.0
Investments .... millions..	$497	$394	−20.7
Employment	41,688	40,556	−2.7
Farm marketing receipts .... millions..	[r] $601.3	$619.5	+3.0
Mineral production .... do....	190	201	+5.8
Utility sales or consumption .... million kilowatt-hours..	47,974	49,282	+2.7
Tennessee River freight traffic:			
Total .... thousand tons..	21,628	22,909	+5.9
Stone, sand and gravel .... do....	6,442	5,991	−7.0
Petroleum products .... do....	1,096	1,099	+.3
Iron and steel products .... do....	316	493	+56.0
Coal and coke .... do....	8,075	8,878	+9.9

[r] Revised.

Sources: Tennessee Valley Authority; Tennessee Executive Department, Staff Division for Industrial Development; U.S. Department of Agriculture; U.S. Department of Commerce; and U.S. Department of Labor.

Government Programs.—The Tennessee Division of Geology and the Tennessee Valley Authority (TVA) continued their programs of geologic mapping and mineral resource evaluation in the State. At yearend, geologic and mineral resource maps covering 37 percent of the State's land area had been published.

The Bureau of Mines and the Tennessee Division of Geology were working under a cooperative agreement to determine the remaining reserves of strippable coal in the northern Cumberland Plateau area. The Bureau of Mines published a report on clays and shales in Kentucky and Tennessee, suitable for use as lightweight aggregate.[3]

The U.S. Geological Survey continued studies on the East Tennessee Zinc District. During the year, papers were published on mineral resources in the State's Appalachian region[4] and on the geology of the Great Smoky Mountain Park.[5]

The completion of 62 miles of interstate highway brought the aggregate interstate mileage to 625; 60 percent of the planned 1,045 miles.

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[3] Hollenbeck, R. P., and M. E. Tyrrell. Shales for Lightweight Aggregate in Appalachian Region, Kentucky and Tennessee. BuMines Rept. of Inv. 7129, 1968, 54 pp.

[4] U.S. Geological Survey and the U.S. Bureau of Mines. Mineral Resources of the Appalachian Region. Geol. Survey Prof. Paper 580, 1968, 492 pp.

[5] King, P. B., R. B. Neuman, and J. B. Hadley. Geology of the Great Smoky Mountains National Park, Tennessee and North Carolina. Geol. Survey Prof. Paper 587, 1968, 23 pp.

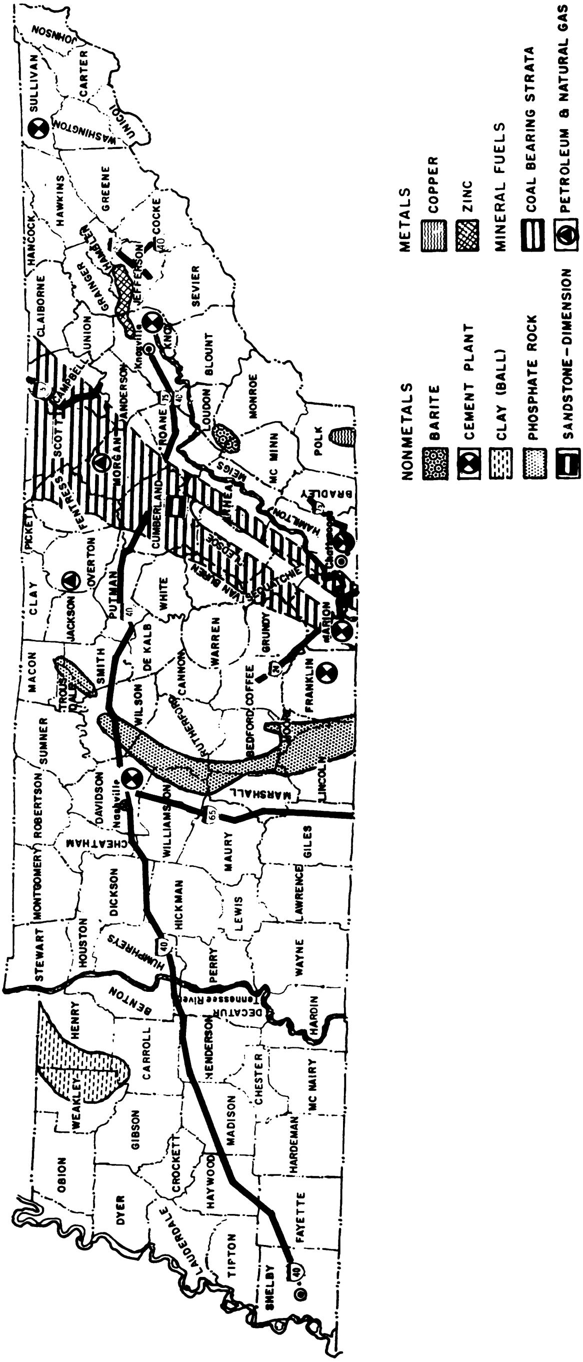

Figure 2.—Generalized Map of Selected Mineral Industries in Tennessee.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1967:								
Coal	1,917	196	375	3,024	4	120	41.00	10,886
Metal	1,672	262	439	3,523	3	107	31.23	7,062
Nonmetal	730	244	178	1,464	-------	36	24.60	585
Sand and gravel	605	251	152	1,330	1	18	14.28	4,938
Stone	2,830	259	734	6,023	-------	102	16.93	2,749
Total [1]	7,754	242	1,879	15,364	8	383	25.45	5,318
1968: p								
Coal	1,920	195	373	2,976	6	106	37.64	13,416
Metal	1,680	275	474	3,792	2	105	28.21	6,745
Nonmetal	665	243	162	1,344	-------	33	24.55	1,111
Sand and gravel	555	256	142	1,217	1	25	21.37	6,891
Stone	2,750	273	751	6,175	3	112	18.62	3,368
Total	7,570	250	1,902	15,504	12	381	25.35	6,201

p Preliminary.

[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Nonmetal production accounted for 63 percent of the value of mineral production in the State. The three principal commodities in order of value were stone, portland cement, and phosphate rock.

Barite.—Three companies produced barite from five mines in the Sweetwater district of east central Tennessee. The ore, mined by open-pit methods, was shipped by rail for use in paints, drilling mud, and chemicals. Shipments increased substantially during the year, primarily due to an improved grade of material mined.

Cement.—Tennessee again was one of the leading States in the manufacture of cement, ranking fifth nationally in masonry cement production. The State's cement industry consists of four companies operating six plants in central and east Tennessee. Four plants produced both masonry and portland cement; two plants produced only portland cement.

Increases in sales and value were recorded for both cement types due, in part, to continued high construction activity and the large rise in specialty cement sales.

Masonry cement shipments and value increased 25 percent and 28 percent, respectively. Out-of-State shipments were to Georgia (28 percent), North Carolina (5 percent), Kentucky (4 percent), Alabama (2 percent), Virginia (2 percent), South Carolina (2 percent), and three other States combined received less than 1 percent of the total shipments. In-State shipments accounted for 56 percent of the total production.

Portland cement shipments and value increased 5 and 8 percent, respectively. Fifty percent of the State's production went to local consumers. Out-of-State shipments were to Georgia (22 percent), North Carolina (18 percent), Virginia (3 percent), Kentucky (3 percent), Alabama (2 percent), South Carolina (1 percent), and five States combined received less than 1 percent.

Clays.—Tennessee produced ball clay, a high-grade ceramic raw material; fuller's earth, an absorbent clay; and miscellaneous clay for use in the manufacture of structural clay products, cement, and refractories. The State ranked first in the Nation in the production of ball clay and fifth in fuller's earth.

Ball clay was produced by open-pit mining from Henry and Weakley Counties in the northwestern part of the State. The clay was air dried and shredded before shipment by rail and barge. End product uses were whiteware (55 percent); floor and wall tile (19 percent), building brick (19 percent), firebrick (6 percent), and miscellaneous uses (1 percent). Total out-

Table 5.—Ball clay sold or used by producers, by uses

(Short tons)

Use	1967	1968
Whiteware, etc	206,992	225,048
Floor and wall tile	64,200	80,300
Other uses [1]	101,031	105,179
Total	372,223	410,527

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[1] Includes art pottery, firebrick and block, kiln furniture, other refractories, heavy clay products, enameling, fillers, and other uses.

put was 411,000 tons, valued at $6 million, an increase of 10 percent over 1967.

Fuller's earth was mined from open pits in Henry County in northwestern Tennessee. The clay was processed by drying, crushing, and calcining. The end product was used as an absorbent material for pet litter. Production increased 27 percent and value increased 23 percent.

Miscellaneous clay was mined by 11 companies throughout the State. Finished products in 1968 were building brick (65 percent), lightweight aggregate (25 percent), cement (9 percent), and refractories (1 percent). Output decreased 4 percent in 1968, but value increased 26 percent.

Graphite.—Production and value of artificial graphite increased during 1968. Artificial graphite is used by the producer in central Tennessee in the manufacture of electrodes.

Lime.—Primary lime produced by two companies in the Knoxville area of east Tennessee, decreased 10 percent in tonnage and 9 percent in value. Principal uses of the lime were waste neutralization, water purification, and in papermaking. Increased acceptance of neutralization and purification agents other than lime and a 4-percent increase in regenerated lime, a product of the causticizing process in the pulp and paper industry, were major reasons for the depressed market. The lime was shipped principally to North Carolina and Tennessee, with minor shipments to 10 other States.

Perlite.—A plant, located in central Tennessee, expanded New Mexico perlite for use in filters, as filter aids, in agriculture and cryogenics. Production and value increased substantially as a result of new market research.

Phosphate Rock.—Tennessee again ranked third in the Nation in the production of phosphate rock. Production and sales were 5 percent higher than in 1967.

The phosphate industry, comprised of five companies, is situated in a six-county area in the central part of the State. Open-pit mining methods are used, and much of the mining is by contract. The ore is shipped by rail and truck to processing plants located within the phosphate area. Over 99 percent of the ore was reduced in electric furnaces to elemental phosphorus for company use and/or open market sales.

Phosphate deposits owned by the Tennessee Valley Authority (TVA) were mined under contract and the ore shipped to the agency's fertilizer manufacturing complex at Muscle Shoals, Ala.

Pyrite.—Tennessee again led the Nation in pyrite output, and a record high was established in 1968. Pyrite concentrates were recovered by flotation from sulfide ore mined in Polk County. Sulfuric acid, iron sinter, and ferric sulfate were produced from the pyrite concentrate.

Sand and Gravel.—Sand and gravel was produced at 48 plants in 32 counties by 44 companies. Output was 8 percent lower than in 1967, but value was 4 percent higher, reflecting the increasing prices of construction materials. The major sand and gravel sources in the State are terrace and alluvial deposits, sandstones, and conglomerates of the Cumberland Plateau, and extensive sand deposits in the western part of the State.

Stationary plants processed 58 percent, dredges 25 percent, and portable plants 17 percent of the total sand and gravel production. The processed material was moved to market by truck (80 percent), railroad (17 percent), and barge (3 percent). The uses of the sand were structural (57 percent), paving (24 percent), molding (7 percent), and miscellaneous (12 percent). The gravel was used for paving (68 percent), structural (23 percent), fill and miscellaneous uses (9 percent).

Stone.—The crushed limestone industry, composed of 77 companies with 120 quarries in 63 counties, was located in central and east Tennessee. Production and value increased 2 percent and 5 percent, respectively, due to increased construction ac-

Table 6.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1967			1968		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Benton	6	871	$1,576	7	959	W
Carroll	1	182	W	1	W	W
Fayette	1	69	77	1	68	$79
Franklin	1	68	W	2	W	W
Gibson	1	323	W	1	W	W
Giles	1	316	156	1	251	151
Grundy	1	154	W	1	152	W
Hardeman	2	105	W	2	W	W
Haywood	1	69	61	1	85	78
Henderson	1	34	W	1	W	W
Lauderdale	1	122	107	1	118	109
Loudon	1	15	W	1	W	W
Monroe	1	33	W	1	W	W
Obion	2	222	W	2	W	345
Putnam	1	114	W	1	W	W
Shelby	7	1,758	1,603	4	786	W
Other counties [1]	18	3,520	7,099	20	4,925	10,378
Total	47	7,975	10,679	48	7,344	11,140

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."

[1] Includes Cumberland, Davidson, Decatur, Greene, Hamilton, Hardin, Humphreys, Knox, McMinn, McNairy, Polk (1968), Sevier, Stewart, Tipton, Unicoi, Washington, and Wayne Counties, and counties indicated by symbol W.

Table 7.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967			1968		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
SAND						
Structural	2,347	$3,145	$1.34	2,471	$3,768	$1.52
Paving	1,029	1,707	1.66	1,054	1,717	1.63
Molding	319	992	3.11	304	1,044	3.43
Other sands [1]	435	902	2.07	515	1,480	2.87
Total	4,130	6,746	1.63	4,344	8,009	1.84
GRAVEL						
Paving	2,560	2,353	.92	2,044	1,843	.90
Structural	876	1,084	1.24	692	968	1.40
Fill	117	79	.68	80	72	.90
Other gravel [2]	292	417	1.43	184	248	1.35
Total	3,845	3,933	1.02	3,000	3,131	1.04
Total sand and gravel	7,975	10,679	1.34	7,344	11,140	1.52

[1] Includes glass, pottery (1968), grinding and polishing, blast (1968), fire and furnace (1968), engine, chemical (1968), fill, and other sands.

[2] Includes railroad ballast, miscellaneous and other gravel.

tivity. Stationary plants accounted for 96 percent of all production. The stone was used in concrete and roads (75 percent), for agricultural purposes (7 percent), in cement manufacture (7 percent), as stone sand (1 percent), and miscellaneous uses (10 percent).

Table 8.—Crushed limestone sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1967			1968		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Anderson	2	501	W	2	W	W
Bradley	2	W	W	2	W	$363
Coffee	2	909	W	2	W	W
Cumberland	2	W	W	2	W	1,233
Davidson	7	4,176	$4,816	7	4,040	4,622
Fentress	1	157	223	1	150	W
Franklin	4	911	1,360	4	884	W
Grainger	1	33	41	1	W	W
Greene	5	286	399	5	W	W
Jefferson	7	1,846	1,848	6	1,894	W
Knox	8	2,175	3,100	8	W	W
Marion	4	1,757	2,059	4	1,404	1,828
Monroe	2	301	373	2	W	W
Pickett	1	50	62	1	2	2
Putnam	3	853	1,046	2	W	W
Rhea	1	124	167	1	W	127
Rutherford	3	W	W	3	783	1,024
Scott	1	30	37	-------	---------	---------
Smith	1	120	149	1	75	94
Unicoi	1	5	6	1	7	8
Union	1	82	101	1	W	W
Washington	5	297	371	6	W	W
White	2	249	W	2	W	W
Other counties [1]	56	16,568	23,798	56	22,802	32,759
Total [2]	122	31,429	39,957	120	32,040	42,060

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."

[1] Includes Bedford, Benton, Blount, Campbell, Cannon, Carter, Claiborne, Clay, Cocke, Decatur, DeKalb, Giles, Grundy, Hamblen, Hamilton, Hancock, Hardin, Hawkins, Humphreys, Johnson, Lincoln, Loudon, Macon, Marshall, Maury, McMinn, Meigs, Montgomery, Overton, Roane, Robertson, Sequatchie, Sevier, Stewart, Sullivan, Sumner, Warren, Wayne, Williamson, and Wilson Counties, and counties indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 9.—Crushed limestone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967			1968		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roads	25,531	$31,929	$1.25	23,813	$30,659	$1.29
Cement	2,207	2,754	1,25	2,354	3,070	1.30
Agstone	2,467	2,998	1.22	2,338	2,986	1.28
Stone sand	247	365	1.47	470	740	1.58
Lime	W	W	W	216	347	1.60
Mine dusting	W	W	W	11	W	W
Whiting	------	--------	--------	3	W	W
Other uses [1]	976	1,910	1.96	2,834	4,258	1.50
Total [2]	31,429	39,957	1.27	32,040	42,060	1.31

[1] Includes riprap, fluxing stone, railroad ballast, glass, paper (1967), asphalt filler, fertilizer filler (1967), other fillers, mineral food, drain fields (1967), other uses, and uses indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Three companies in eastern Tennessee crushed marble for terrazzo, mineral food, and agricultural use. Production decreased 23 percent and value only 3 percent.

The crushed sandstone industry, located in the northern part of the Cumberland Plateau, consists of three companies. Two companies crushed sandstone as a primary product, and a third crushed scrap from a dimension stone operation. Production and value increased over that of 1967.

Dimension stone was quarried by 11 companies in eastern Tennessee.

Seven companies quarried dimension sandstone from a two-county area in the northern part of the Cumberland Plateau. The sandstone was used for architectural house veneer (26 percent), rough construction (20 percent), rough architectural (19 percent), architectural dressed (13 percent), flagging and sawed architectural (8 percent), and rubble (14 percent). Production and value increased 2 percent and 20 percent, respectively.

Dimension marble was quarried by four companies in a four-county area in east Tennessee. Sales were architectural rough blocks (65 percent), cut stone (15 percent), sawed stone (19 percent), and rubble (1 percent). Production increased 17 percent, but value was down 39 percent.

Vermiculite.—One company in central Tennessee exfoliated vermiculite for use in insulation, aggregate, and agriculture.

METALS

Metals accounted for 23 percent of the total mineral production value in the State. Zinc and copper were again the principal metal commodities produced. The only significant decrease in production were gold and silver; these decreases were attributed to a slight decrease in the amount of copper produced, combined with a lower gold and silver content in the ore. Rising unit prices of both commodities helped to offset part of the volume loss.

Aluminum.—Tennessee's aluminum industry consists of two primary and one secondary smelters. The primary smelters were operated by the Aluminum Company of America (Alcoa) at Alcoa in east Tennessee and by Consolidated Aluminum Corporation (Conalco) at New Johnsonville in western Tennessee. The secondary smelter was operated by Excel Smelting Corp. at Memphis in the extreme southwestern corner of the State.

Alumina for the Alcoa facility was shipped to east Tennessee from Mobile, Ala., and made into sheet, plate, foil, powder, and tube aluminum products. Alcoa's primary aluminum capacity at yearend was 125,000 short tons.

Conalco purchased alumina from Swiss Aluminium Ltd. for use in the New Johnsonville facility where it was processed into sheet and foil aluminum products. Conalco increased primary aluminum capacity to 140,000 short tons in 1968 with the completion of a new potline.

The secondary smelter of Excel Smelting Company used scrap aluminum as smelter feed.

Copper.—Copper was produced from sulfide ore from five underground mines in the Ducktown-Copper Hill district in Polk County, in the extreme southeastern part of the State. In 1968 production decreased 3 percent, but value was up 6 percent. Copper flotation concentrate was processed to 99 percent purity and then shipped out of State for final refining.

Ferroalloys.—Tennessee's ferroalloy industry consisted of five companies which operated six plants. Production consisted of ferromanganese, spiegeleisen, silicomanganese, ferrosilicon, ferrophosphorus, and ferrochromium. Output of all ferroalloys during the year totaled 119,627 short tons valued at $14,592,000.

Three plants in central Tennessee produced ferrophosphorus as a byproduct of elemental phosphorus output.

Gold.—Gold recovery, a byproduct of copper refining, declined 23 percent in volume and 17 percent in value.

Manganese.—Foote Mineral Co. placed on stream its new electrolytic manganese plant at New Johnsonville in western Tennessee. Annual production capacity of the company's New Johnsonville and Knoxville plants is now 50 million pounds.

Silver.—Byproduct silver, recovered in the refining of blister copper, decreased 31 percent in quantity and 5 percent in value.

Titanium.—E. I. du Pont de Nemours and Co., Inc., announced plans to expand the capacity of its titanium dioxide pigment plant at New Johnsonville. This will be the fourth expansion since the plant was built in 1959, and will increase capacity by 20 percent.

Zinc.—Tennessee continued to lead the Nation in zinc production with 23 percent of the Nation's total. Four companies operated nine mines in northeastern Tennessee. Zinc concentrates were also recovered from the processing of copper-zinc ore by one company in southeastern Ten-

Table 10.—Mine production of recoverable gold, silver, copper, lead, and zinc

Commodity	1967			1968			Earliest record to date	
	Number of producers	Quantity	Value (thousands)	Number of producers	Quantity	Value (thousands)	Quantity	Value (thousands)
Gold______troy ounces__	1	181	$6	1	140	$5	25,036	$619
Silver__________do____	1	130,078	202	1	89,525	192	4,583,596	3,878
Copper_____short tons__	1	14,600	11,162	1	14,196	11,881	620,013	256,676
Lead____________do____	-------	-------	-------	-------	-------	-------	27,324	3,240
Zinc____________do____	5	113,065	31,303	5	124,039	33,491	2,271,412	506,397
Total__________	XX	XX	42,673	XX	XX	45,569	XX	770,810

XX Not applicable.

nessee. The ores were processed by flotation and the concentrates shipped to smelters in Illinois, Missouri, New York, Ohio, Oklahoma, Pennsylvania, and Texas. Total ore milled in the State was about 6 million tons, an increase of 9.2 percent over 1967 output.

American Zinc Co.'s Immel mine began production in March at an initial rate of 400 tons daily, which was increased to 900 tons daily by June. Drilling and development work by American Zinc Co. and New Market Zinc Co. increased reserves substantially.

New Jersey Zinc Co. continued exploration work in central Tennessee and was leasing acreage at yearend.

MINERAL FUELS

Mineral fuels accounted for 15 percent of the State's total mineral production value.

Coal (Bituminous).—Coal production from 182 mines in the Cumberland Plateau region of east central Tennessee increased 19 percent and value increased 10 percent. The two coal producing areas in the State, District 8 in the north and District 13 in the south, produced over 8 million tons during the year.

In District 8, 6 million tons of coal were produced from 131 mines in nine counties, an average of 36,000 tons per mine. Coal was mined in District 8 by underground (56 percent), strip (40 percent), and auger (4 percent) methods. Coal shipments were by rail (73 percent) and truck (27 percent). Coal production from District 13 was 2 million tons from 51 mines in seven counties, an average of 48,000 tons per mine. Mining methods in District 13 were underground (59 percent) and strip (41 percent). Shipments were by rail and water (76 percent), truck (21 percent), other methods (3 percent).

At yearend the TVA announced a significant price increase for coal for power plant feed. The price increase was attributed to higher labor, materials, shipping costs, and reclamation costs of the suppliers.

Coke.—Coke and breeze were produced by one company in 44 ovens. Coal chemicals produced included coke oven gas, ammonium sulfate, tar, and crude light oil (converted to industrial-grade benzene), toluene, and crude naphtha.

Natural Gas.—Exploration during the year resulted in the discovery in northern Tennessee of one new gasfield and the drilling of five field extension wells. Total gas production for the year was 47,617 million cubic feet.

Petroleum.—1968 was the first year in a number of years that no new petroleum discoveries were made. The 6,000 barrels of crude oil produced during the year brought the State's cumulative production since 1916 to 705,000 barrels.

Table 11.—Coal (bituminous) production[1] in 1968, by counties

(Thousand tons and thousand dollars)

County	Number of mines in operation			Production[2]				
	Underground	Strip	Auger	Underground	Strip	Auger	Total	
							Quantity	Value
Anderson	24	10	2	1,477	582	45	2,104	W
Bledsoe	-------	1	-------	-------	W	-------	W	W
Campbell	16	19	4	285	1,205	93	1,583	$5,838
Claiborne	6	3	1	1,005	W	W	1,298	W
Cumberland	-------	1	-------	-------	W	-------	W	W
Fentress	5	-------	1	36	-------	60	96	342
Grundy	-------	1	-------	-------	W	-------	W	W
Hamilton	3	1	-------	12	W	-------	W	W
Marion	25	-------	-------	1,003	-------	-------	1,003	W
Morgan	9	9	-------	97	276	-------	373	1,445
Overton	6	-------	-------	32	-------	-------	32	W
Putnam	1	-------	-------	W	-------	-------	W	W
Rhea	2	-------	-------	19	-------	-------	19	78
Scott	8	5	1	W	193	W	766	2,544
Sequatchie	8	4	-------	50	W	-------	W	W
Van Buren	1	5	-------	1	286	-------	288	980
Undistributed[3]	-------	-------	-------	607	750	34	588	18,420
Total[2]	114	59	9	4,624	3,292	232	8,148	29,647
Earliest record to date	-------	-------	-------	-------	-------	-------	445,754	NA

NA Not available. W Withheld to avoid disclosing individual company confidential data; included in "Undistributed."

[1] Excludes mines producing less than 1,000 short tons.

[2] Data may not add to totals shown because of independent rounding.

[3] Includes mines and value indicated by symbol W.

Table 12.—Oil and gas well drilling in 1968

County	Development wells		Exploratory wells		
	Dry	Footage	Gas	Dry	Footage
Bledsoe	----	----	----	1	470
Clay	1	468	----	4	2,778
Coffee	----	----	----	1	435
Dickson	----	----	----	4	2,609
Gibson	----	----	----	1	7,164
Henry	----	----	----	2	11,718
Jackson	----	----	----	1	500
Macon	----	----	3	----	2,169
Overton	----	----	----	1	700
Pickett	----	----	----	1	900
Robertson	----	----	----	1	1,901
Scott	----	----	2	1	10,274
Smith	----	----	1	----	238
Sumner	----	----	----	1	270
Total	1	468	6	19	42,126

Source: American Association of Petroleum Geologists.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum smelters:			
Consolidated Aluminum Corp.	1100 Richmond St. Jackson, Tenn. 38310	Plant	Madison.
Aluminum Company of America.	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	do	Blount.
Barite:			
Godsey Mines, Inc	Box 227 Sweetwater, Tenn. 37874	3 open-pit mines and 2 plants.	McMinn and Monroe.
National Lead Co	Box 1675 Houston, Tex. 77001	Open-pit mine and plant.	Do.
B. C. Wood	Box 284 Sweetwater, Tenn. 37874	do	Loudon.
Cement:			
General Portland Cement Co.	1300 American National Bank Bldg. Chattanooga, Tenn. 37402	Plant	Hamilton.
Ideal Cement Co	620 Ideal Cement Bldg. Denver, Colo. 80202	do	Knox.
Marquette Cement Mfg. Co.	20 N. Wacker Drive Chicago, Ill. 60606	2 plants	Davidson and Franklin.
Penn-Dixie Cement Corp.	Box 152 Nazareth, Pa. 18064	do	Marion and Sullivan.
Clay:			
Ball:			
Bell Clay Co	Gleason, Tenn. 38229	4 open-pit mines and plant.	Weakley.
Cyprus Mines Corp.	Box 1201 Trenton, N.J. 08618	Open-pit mine and plant.	Do.
Kentucky-Tennessee Clay Co.	Box 77 Mayfield, Ky. 42066	do	Henry.
Laird Brick Co., Inc.	Puryear, Tenn. 38251	do	Do.
H. C. Spinks Clay Co., Inc.	Box 829 Paris, Tenn. 38242	2 open-pit mines and plant.	Henry and Weakley.
Fuller's earth: Southern Clay Co., Inc.	Box 838 Paris, Tenn. 38242	Open-pit mine and plant.	Henry.
Miscellaneous:			
W. G. Bush & Co., Inc.	1136 2d Ave. North Nashville, Tenn. 37208	do	Davidson.
General Shale Products Corp.	Box 60 Johnson City, Tenn. 37601	4 open-pit mines and plants.	Hamilton, Knox, Sullivan, Washington.
Old Hickory Brick Co., Inc.	Greenback, Tenn. 37742	Open-pit mine and plant.	Loudon.
Shalite Corp	Box 441 Knoxville, Tenn. 37901	do	Knox.
Tennlite, Inc	Green Brier, Tenn. 37073	do	Davidson.
Coal:			
Consolidation Coal Co	Box 460 Middlesboro, Ky. 40965	2 underground mines and plants.	Anderson and Claiborne.
Grundy Mining Co	Box 874 Jasper, Tenn. 37347	Underground mine.	Marion.
Pee Wee Mining Co., Inc.	1337 Western Ave. Knoxville, Tenn. 37921	do	Scott
Tennco, Inc	Box 498 Lake City, Tenn. 37769	3 strip and 2 auger mines	Anderson.
Tennessee Auger Co., Inc.	do	3 underground mines.	Do.
Coke: Woodward Iron Co	4800 Central Ave. Chattanooga, Tenn. 37410	Plant	Hamilton.
Copper: Tennessee Copper Co.	Copperhill, Tenn. 37317	5 underground mines, mill, smelter, chemical plant.	Polk.
Ferroalloys:			
Chromium Mining and Smelting Co.	3720 Place Victoria Montreal, Quebec, Canada	Plant	Shelby.
Hooker Chemical Corp	Box 591 Columbia, Tenn. 38402	do	Maury.
Mobil Chemical Co	Box 1136 Richmond, Va. 23208	do	Do.
Monsanto Co	800 N. Lindbergh Blvd. St. Louis, Mo. 63141	do	Do.
Stauffer Chemical Co	299 Park Ave. New York, N.Y. 10017	do	Do.
Union Carbide Corp	270 Park Ave. New York, N.Y. 10017	do	Roane.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Gold: Tennessee Copper Co.	Copperhill, Tenn. 37317	*See* Copper	Polk.
Graphite, artificial: Union Carbide Corp.	270 Park Ave. New York, N.Y. 10017	Plant	Maury.
Lime:			
Primary:			
Foote Mineral Co.	Rt. 8, Asbury Rd. Knoxville, Tenn. 37914	Limekiln	Knox.
Williams Lime Mfg. Co.	Box 2286 Knoxville, Tenn. 37901	do	Do.
Regenerated: [1]			
Bowaters Southern Paper Co.	Calhoun, Tenn. 37309	Rotary kiln	McMinn.
The Mead Corp.	Kingsport, Tenn. 37660	do	Sullivan.
Tennessee River Pulp & Paper Co.	Counce, Tenn. 38326	do	Hardin.
Natural gas: Citizens Gas Utility.	Oneida, Tenn. 37841	20 wells	Morgan and Scott.
Perlite, expanded: Chemrock Corp.	Osage St. Nashville, Tenn. 37208	Plant	Davidson.
Petroleum:			
Allen Bales	1726 N. Washington Cookeville, Tenn. 38501	Well	Clay.
David Law	Box 1751, Garrity Bldg. Parkersburg, W. Va. 26101	do	Scott.
Mack Petroleum Co.	Box 629 Knoxville, Tenn. 37901	4 wells	Morgan.
Pemberton Oil & Lumber Co.	Oneida, Tenn. 37841	13 wells	Morgan and Scott.
Petroleum, refinery: Delta Refinery Co.	543 W. Mallory Ave. Memphis, Tenn. 38106	Refinery	Shelby.
Phosphate rock:			
Hooker Chemical Corp.	Box 591 Columbia, Tenn. 38402	Mine and plant	Maury.
Monsanto Co.	800 N. Lindbergh Blvd. St. Louis, Mo. 63141	5 mines and plants	Davidson, Giles, Maury Sumner, Williamson.
Presnell Phosphate Co., Inc.	Presnell Bldg. Columbia, Tenn. 38401	Mine and plant	Maury.
Stauffer Chemical Co.	299 Park Ave. New York, N.Y. 10017	2 mines and plants.	Do.
M. C. West, Inc.	Box 381 Columbia, Tenn. 38402	Mine and plant	Hickman.
Pyrite: Tennessee Copper Co.	Copperhill, Tenn. 37317	*See* Copper	Polk.
Sand and gravel:			
Dixie Sand & Gravel Co.	515 River St. Chattanooga, Tenn. 37402	Dredge	Hamilton.
Hardy Sand Co.	Box 629 Evansville, Ind. 47702	3 open-pit mines	Benton and Carroll.
Ingram Material, Inc.	Box 5278 Nashville, Tenn. 37206	Dredge	Davidson.
Memphis Stone & Gravel Co.	Box 6247 Memphis, Tenn. 38106	2 open-pit mines	Benton and Shelby.
Sangravel Co., Inc.	1136 2d Ave. North Nashville, Tenn. 37208	Dredge	Humphrey.
Silver: Tennessee Copper Co.	Copperhill, Tenn. 37317	*See* Copper	Polk.
Stone:			
Limestone, crushed:			
American Zinc Co.	20 S. 4th St. St. Louis, Mo. 63102	*See* Zinc	Jefferson and Knox.
Lambert & Lambert Stone Co., Inc.	Box 2098 Chattanooga, Tenn. 37409	4 quarries	Bedford, Hamilton, Rutherford, Warren.
Menefee Crushed Stone Co., Inc.	Box 387 Nashville, Tenn. 37202	2 quarries	Davidson and Sumner.
Ralph Rogers & Co., Inc.	720 Argyle Ave. Nashville, Tenn. 37203	3 quarries	Anderson, Coffee, and Sumner.
Vulcan Materials Co.	Box 7 Knoxville, Tenn. 37901	21 quarries	Benton, Blount, Claiborne, Cocke, Davidson, Decatur, Hamilton, Hardin, Hawkins, Humphreys, Knox, Loudon, Marion, Sevier, Sullivan, Wayne, and Williamson.
Marble, crushed:			
Appalachian Marble Co.	2607 Middlebrook Pike Knoxville, Tenn. 37921	2 quarries and mill.	Knox.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Marble, crushed—Continued			
John J. Craig Co	Box 9300 Knoxville, Tenn. 37920	3 quarries	Blount and Loudon.
Knoxville Crushed Stone Co.	121 Stone Road Knoxville, Tenn. 37920	Quarry	Knox.
Marble, dimension:			
Appalachian Marble Co.	2607 Middlebrook Pike Knoxville, Tenn. 37921	2 quarries and mill.	Do.
John J. Craig Co	Box 9300 Knoxville, Tenn. 37920	3 quarries	Blount and Loudon.
Georgia Marble Co	Box 1550 Knoxville, Tenn. 37901	2 quarries and mill.	Knox and Union.
Imperial Black Marble Corp.	801 Bluff Drive Knoxville, Tenn. 37919	Quarry	Grainger.
Sandstone, crushed:			
Gamble Asphalt Materials Co.	Crossville, Tenn. 38555	do	Cumberland.
Turner Bros. Stone Co., Inc.	do	do	Do.
White Silica Sand Co., Inc.	Box 6056 Knoxville, Tenn. 37914	do	Campbell.
Sandstone, dimension:			
Bowman Stone Co	Crab Orchard, Tenn. 37723	do	Cumberland.
Ross L. Brown Cut Stone Co., Inc.	do	Quarry and mill	Do.
Crab Orchard Stone Co., Inc.	Box 238 Crossville, Tenn. 38555	do	Do.
Cumberland Mountain Stone Co.	Crab Orchard, Tenn. 37723	Quarry	Do.
Turner Bros. Stone Co., Inc.	Crossville, Tenn. 38555	do	Do.
Vermiculite, exfoliated: W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Plant	Davidson.
Zinc:			
American Zinc Co	20 S. 4th St. St. Louis, Mo. 63102	5 underground mines and mill.	Jefferson and Knox.
New Jersey Zinc Co	160 Front St. New York, N.Y. 10038	2 underground mines and mills.	Hancock and Jefferson.
New Market Zinc Co	Box 66 New Market, Tenn. 37820	Underground mine and mill.	Do.
Tennessee Copper Co	Copperhill, Tenn. 37317	*See* Copper	Polk.
U.S. Steel Corp	Box 599 Fairfield, Ala. 35064	Underground mine and mill.	Jefferson.

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[1] Data on regenerated lime will not be published after this year (1968).

The Mineral Industry of Texas

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Bureau of Economic Geology, The University of Texas at Austin, for collecting information on all minerals except fuels.

By F. F. Netzeband [1] and Roselle Girard [2]

Texas, with a new record $5.5 billion output of minerals in 1968, led the Nation for the 34th consecutive year, and for the 26th consecutive year mineral value exceeded $1 billion. Texas ranked first in production of crude oil, natural gas, natural gas liquids, and magnesium metal. Important quantities of helium, sulfur, bromine, iron ore, clays, lime, salt, sand and gravel, stone, and uranium were also produced. Mineral production was obtained from 241 of the State's 254 counties in 1968. Crude oil was produced in 202 counties, natural gas in 205, natural gas liquids in 118, nonmetallic minerals in 162, and metallic minerals in seven.

Table 1.—Mineral production in Texas [1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Cement:				
Portland thousand 376-pound barrels	31,944	$99,329	34,499	$107,532
Masonry thousand 280-pound barrels	888	2,847	1,059	3,371
Clays thousand short tons	4,497	8,081	4,687	8,860
Gem stones	NA	150	NA	150
Gypsum thousand short tons	984	3,419	1,039	3,616
Helium:				
Grade A thousand cubic feet	335,900	9,900	362,100	9,400
Crude do	977,600	10,246	1,038,700	11,100
Lime thousand short tons	1,564	20,713	1,564	21,154
Natural gas million cubic feet	7,188,900	948,935	7,495,414	1,011,881
Natural gas liquids:				
Natural gasoline and cycle products thousand 42-gallon barrels	95,991	277,105	97,075	269,182
LP gases do	177,367	320,326	189,162	278,068
Petroleum (crude) do	1,119,962	3,375,565	1,133,380	3,450,707
Salt thousand short tons	8,344	36,435	8,534	42,663
Sand and gravel do	31,398	39,170	31,843	41,546
Stone (includes basalt and shell) do	49,424	61,577	48,480	58,006
Sulfur (Frasch process) thousand long tons	3,448	111,931	2,571	105,482
Talc short tons	90,836	356	125,880	517
Value of items that cannot be disclosed: Asphalt (native), bromine, coal (lignite), graphite, iron ore (usable), magnesium chloride (for metal), magnesium compounds (except for metal), mercury, perlite (1967), pumicite, sodium sulfate, uranium (recoverable content U_3O_8), and crude vermiculite	XX	80,286	XX	82,596
Total	XX	5,406,371	XX	5,505,831
Total 1957–59 constant dollars	XX	5,218,591	XX	p 5,295,471

p Preliminary. XX Not applicable. NA Not available.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

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[1] Mining engineer, Bureau of Mines, Dallas, Tex.

[2] Geologist, Bureau of Economic Geology, The University of Texas at Austin, Austin, Tex.

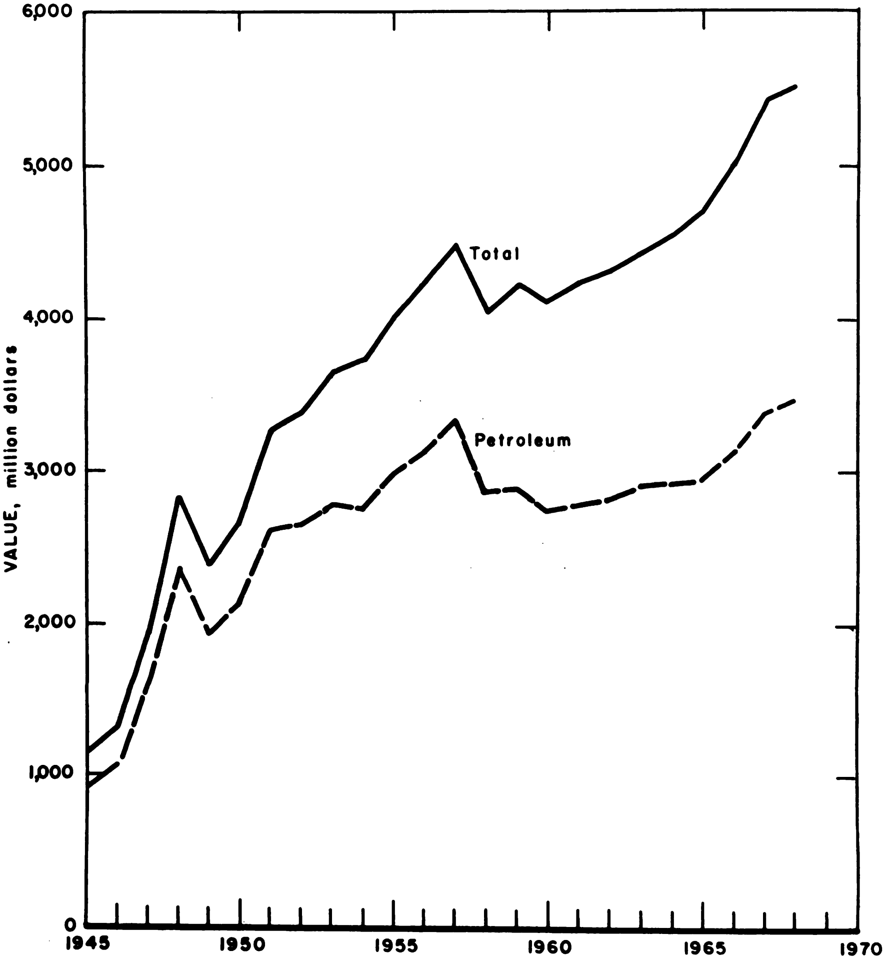

Figure 1.—Value of petroleum and total value of mineral production in Texas.

Table 2.—Value of mineral production in Texas, by counties[1]

(Thousands)

County	1967 r	1968	Minerals produced in 1968 in order of value
Anderson	$24,815	$28,013	Petroleum, natural gas, natural gas liquids.
Andrews	262,432	250,951	Petroleum, natural gas liquids, natural gas.
Angelina	310	267	Clays, natural gas, petroleum.
Aransas	9,304	14,260	Petroleum, natural gas, natural gas liquids, shell.
Archer	29,796	25,429	Petroleum, natural gas, natural gas liquids, sand and gravel.
Armstrong	---------	830	Sand and gravel.
Atascosa	17,061	20,218	Petroleum, natural gas, natural gas liquids.
Austin	6,901	6,958	Petroleum, natural gas, sand and gravel.
Bastrop	920	802	Clays, petroleum, natural gas.
Baylor	4,366	3,918	Petroleum, sand and gravel, natural gas.
Bee	29,936	20,631	Natural gas, petroleum, natural gas liquids, stone.

See footnotes at end of table.

Table 2.—Value of mineral production in Texas, by counties[1]—Continued

(Thousands)

County	1967[r]	1968	Minerals produced in 1968 in order of value
Bell	$227	W	Sand and gravel, stone.
Bexar	26,819	$27,808	Cement, stone, sand and gravel, petroleum, natural gas liquids, clays, natural gas.
Blanco	134	17	Sand and gravel.
Borden	22,854	28,397	Petroleum, natural gas, sand and gravel.
Bosque	W	W	Stone, sand and gravel.
Bowie	123	152	Petroleum, natural gas.
Brazoria	218,312	232,265	Petroleum, natural gas liquids, natural gas, salt, magnesium chloride, bromine, magnesium compounds, lime, sulfur, sand and gravel.
Brazos	W	W	Sand and gravel, petroleum, natural gas.
Brewster	W	W	Mercury, clays.
Briscoe	---------	13	Sand and gravel.
Brooks	33,496	43,104	Natural gas, petroleum, natural gas liquids.
Brown	2,533	2,281	Stone, petroleum, natural gas, clays.
Burleson	18	155	Stone, petroleum, natural gas.
Burnet	5,112	5,170	Stone, graphite, sand and gravel.
Caldwell	16,516	13,161	Petroleum, stone, natural gas, sand and gravel.
Calhoun	28,638	21,451	Natural gas, petroleum, natural gas liquids, lime, shell, sand and gravel.
Callahan	5,543	5,000	Petroleum, natural gas, natural gas liquids.
Cameron	1,137	1,641	Natural gas, petroleum.
Camp	2,704	2,536	Petroleum, natural gas.
Carson	28,301	15,808	Petroleum, natural gas liquids, natural gas.
Cass	16,343	17,849	Natural gas liquids, petroleum, natural gas, iron ore.
Chambers	99,403	89,064	Petroleum, natural gas, salt, shell, natural gas liquids, clays.
Cherokee	5,976	6,194	Petroleum, natural gas liquids, natural gas, clays, iron ore.
Childress	340	476	Petroleum, sand and gravel, natural gas.
Clay	15,187	13,736	Petroleum, natural gas, stone, sand and gravel.
Cochran	34,930	41,084	Petroleum, natural gas, natural gas liquids.
Coke	26,303	25,329	Petroleum, natural gas liquids, natural gas, sand and gravel.
Coleman	6,244	5,247	Petroleum, natural gas, natural gas liquids, stone, clays.
Collin	612	17	Stone, sand and gravel.
Collingsworth	1,340	3,519	Natural gas, petroleum, sand and gravel.
Colorado	47,246	51,111	Natural gas liquids, natural gas, sand and gravel, petroleum.
Comal	W	W	Lime, stone.
Comanche	433	240	Stone, natural gas, petroleum, natural gas liquids, clays.
Concho	1,488	1,544	Petroleum, natural gas, natural gas liquids.
Cooke	32,777	32,664	Petroleum, natural gas liquids, natural gas, stone, sand and gravel.
Cottle	2	32	Petroleum, sand and gravel, natural gas.
Crane	206,064	178,094	Petroleum, natural gas, natural gas liquids.
Crockett	31,656	34,935	Do.
Crosby	1,355	951	Sand and gravel, petroleum, natural gas.
Culberson	2,826	3,064	Petroleum, natural gas.
Dallam	49	37	Natural gas.
Dallas	16,549	13,807	Cement, sand and gravel, stone, clays.
Dawson	30,327	33,045	Petroleum, natural gas liquids, natural gas, stone.
Denton	157	871	Sand and gravel, petroleum, natural gas.
De Witt	21,623	16,621	Natural gas, petroleum, natural gas liquids, sand and gravel, stone.
Dickens	127	177	Petroleum, sand and gravel, natural gas.
Dimmit	932	1,107	Petroleum, natural gas.
Donley	397	46	Sand and gravel.
Duval	32,317	33,837	Petroleum, natural gas, salt, natural gas liquids, sand and gravel.
Eastland	5,044	4,029	Petroleum, natural gas liquids, natural gas, clays, stone.
Ector	252,394	253,797	Petroleum, natural gas, natural gas liquids, cement, stone, sand and gravel.
Edwards	101	74	Petroleum, natural gas.
Ellis	18,903	24,443	Cement, stone, clays.
El Paso	5,590	7,194	Cement, stone, sand and gravel.
Erath	2,057	678	Natural gas, petroleum.
Falls	63	52	Petroleum, natural gas.
Fayette	1,912	1,928	Sand and gravel, petroleum, clays, natural gas, stone.
Fisher	23,481	22,731	Petroleum, natural gas, gypsum, natural gas liquids, clays, stone.
Floyd	W	W	Sand and gravel.
Foard	2,889	2,223	Petroleum, natural gas.
Fort Bend	52,348	57,635	Petroleum, sulfur, natural gas, salt, natural gas liquids, clays, sand and gravel.
Franklin	11,552	14,095	Petroleum, natural gas liquids, natural gas.
Freestone	2,575	3,601	Natural gas, stone, petroleum, natural gas liquids, clays.
Frio	4,273	4,614	Petroleum, natural gas, natural gas liquids.
Gaines	110,216	124,859	Petroleum, natural gas, natural gas liquids, sodium sulfate, stone.
Galveston	59,261	57,437	Petroleum, natural gas, natural gas liquids, shell, clays, sand and gravel.
Garza	16,176	14,976	Petroleum, natural gas.
Gillespie	W	W	Stone, gypsum, sand and gravel, talc.

See footnotes at end of table.

Table 2.—Value of mineral production in Texas, by counties[1]—Continued

(Thousands)

County	1967[r]	1968	Minerals produced in 1968 in order of value
Glasscock	$26,813	$11,414	Petroleum, natural gas.
Goliad	17,468	12,326	Do.
Gonzales	1,345	1,827	Natural gas, petroleum, clays, sand and gravel.
Gray	52,938	41,505	Petroleum, natural gas liquids, natural gas.
Grayson	29,392	29,974	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
Gregg	132,102	133,998	Petroleum, natural gas, natural gas liquids.
Grimes	226	172	Petroleum, natural gas.
Guadalupe	9,341	10,891	Petroleum, sand and gravel, clays, natural gas.
Hale	6,689	7,563	Petroleum, natural gas, natural gas liquids.
Hall	6	46	Sand and gravel.
Hamilton	144	150	Natural gas, stone.
Hansford	29,657	23,905	Natural gas, natural gas liquids, helium, petroleum, sand and gravel.
Hardeman	7,752	5,225	Petroleum, gypsum, natural gas liquids, natural gas.
Hardin	28,770	30,122	Petroleum, natural gas, natural gas liquids, sand and gravel.
Harris	130,694	127,514	Petroleum, cement, natural gas liquids, natural gas, salt, lime, sand and gravel, clays.
Harrison	15,473	15,462	Petroleum, natural gas, natural gas liquids, coal, clays.
Hartley	2,317	137	Petroleum, natural gas.
Haskell	10,338	10,597	Petroleum, natural gas, stone.
Hays	W	W	Sand and gravel, stone.
Hemphill	4,398	5,171	Natural gas, petroleum.
Henderson	20,365	26,066	Petroleum, natural gas, natural gas liquids, clays, sand and gravel.
Hidalgo	27,655	34,730	Natural gas, natural gas liquids, petroleum, sand and gravel, stone, clays.
Hill	1,583	1,064	Lime, stone, sand and gravel, petroleum.
Hockley	62,452	71,692	Petroleum, natural gas liquids, natural gas.
Hood	80	118	Natural gas, sand and gravel, stone.
Hopkins	6,965	7,606	Petroleum, natural gas, natural gas liquids, clays.
Houston	8,676	7,384	Petroleum, natural gas, natural gas liquids, sand and gravel.
Howard	49,644	51,538	Petroleum, natural gas liquids, natural gas, stone, sand and gravel.
Hudspeth	501	W	Talc, stone, gypsum.
Hunt	157	182	Natural gas, petroleum.
Hutchinson	47,737	36,642	Petroleum, natural gas liquids, natural gas, sand and gravel, stone, salt.
Irion	3,885	4,114	Petroleum, natural gas, natural gas liquids.
Jack	17,846	22,668	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
Jackson	77,363	82,461	Petroleum, natural gas, natural gas liquids.
Jasper	2,189	2,025	Petroleum, natural gas, lime, sand and gravel, clays.
Jefferson	87,098	74,864	Petroleum, sulfur, natural gas, natural gas liquids, salt, sand and gravel, shell, clays.
Jim Hogg	20,390	22,683	Petroleum, natural gas, natural gas liquids.
Jim Wells	63,465	75,665	Do.
Johnson	2,644	2,790	Lime, stone, sand and gravel.
Jones	11,261	9,853	Petroleum, natural gas liquids, sand and gravel, natural gas, stone.
Karnes	29,938	26,209	Petroleum, uranium, natural gas, natural gas liquids.
Kaufman	1,880	2,222	Petroleum, stone, natural gas.
Kenedy	11,888	18,170	Natural gas, petroleum, natural gas liquids.
Kent	39,343	50,741	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
Kerr	W	W	Sand and gravel.
Kimble	W	42	Sand and gravel, natural gas, petroleum.
King	3,242	3,489	Petroleum, natural gas, sand and gravel.
Kleberg	136,068	171,248	Petroleum, natural gas, natural gas liquids.
Knox	5,887	5,885	Petroleum, natural gas.
Lamar	----------	22	Stone.
Lamb	2,063	2,358	Petroleum, stone, natural gas.
Lampasas	43	16	Sand and gravel.
LaSalle	970	1,162	Petroleum, natural gas.
Lavaca	13,377	10,500	Natural gas liquids, natural gas, petroleum.
Lee	152	61	Petroleum, stone, sand and gravel, natural gas.
Leon	5,118	4,585	Petroleum, natural gas, natural gas liquids, stone.
Liberty	41,884	51,859	Petroleum, sulfur, natural gas, natural gas liquids, sand and gravel.
Limestone	3,346	3,208	Natural gas, petroleum, sand and gravel, clays, stone.
Lipscomb	16,319	16,916	Petroleum, natural gas.
Live Oak	36,287	23,136	Natural gas, petroleum, natural gas liquids.
Llano	514	543	Stone, vermiculite.
Loving	10,008	8,923	Petroleum, natural gas.
Lubbock	917	945	Petroleum, sand and gravel, natural gas.
Lynn	1,558	1,293	Petroleum, natural gas.

See footnotes at end of table.

Table 2.—Value of mineral production in Texas, by counties[1]—Continued

(Thousands)

County	1967[r]	1968	Minerals produced in 1968 in order of value
McCulloch	W	W	Sand and gravel, stone, petroleum.
McLennan	$7,096	$6,496	Cement, sand and gravel, natural gas liquids, stone, clays, petroleum, natural gas.
McMullen	7,954	10,474	Natural gas, petroleum, natural gas liquids.
Madison	4,400	4,813	Natural gas, petroleum, natural gas liquids, stone.
Marion	6,132	7,019	Petroleum, natural gas, natural gas liquids.
Martin	8,290	8,103	Petroleum, natural gas.
Mason	26	136	Stone, sand and gravel.
Matagorda	81,913	81,459	Natural gas, petroleum, natural gas liquids, shell, sulfur, sand and gravel.
Maverick	4,208	5,013	Petroleum, natural gas liquids, natural gas.
Medina	773	711	Petroleum, clays, natural gas.
Menard	698	915	Petroleum, natural gas.
Midland	67,140	77,269	Petroleum, natural gas liquids, natural gas, stone, sand and gravel.
Milam	W	W	Coal, petroleum, sand and gravel, natural gas.
Mills	56	7	Stone.
Mitchell	13,346	10,181	Petroleum, natural gas, sand and gravel.
Montague	17,453	15,589	Petroleum, natural gas, natural gas liquids, sand and gravel.
Montgomery	34,315	34,934	Do.
Moore	69,480	34,852	Natural gas liquids, helium, natural gas, petroleum.
Morris	W	W	Iron ore.
Motley	1,069	1,132	Petroleum, sand and gravel, natural gas.
Nacogdoches	5,052	5,163	Natural gas, petroleum, natural gas liquids, clays.
Navarro	5,686	4,668	Petroleum, natural gas, clays, sand and gravel.
Newton	5,462	5,434	Petroleum, natural gas, natural gas liquids.
Nolan	28,740	28,319	Petroleum, cement, natural gas, gypsum, natural gas liquids, stone, sand and gravel.
Nueces	87,594	98,536	Natural gas, petroleum, natural gas liquids, cement, lime, shell, sand and gravel.
Ochiltree	28,693	28,793	Petroleum, natural gas, natural gas liquids.
Oldham	W	W	Sand and gravel, clays.
Orange	12,778	10,979	Petroleum, cement, natural gas, clays, natural gas liquids.
Palo Pinto	5,622	3,640	Natural gas, stone, petroleum, clays, sand and gravel.
Panola	36,560	38,456	Natural gas, natural gas liquids, petroleum.
Parker	3,464	3,705	Natural gas liquids, natural gas, stone, clays, petroleum, sand and gravel.
Pecos	77,930	125,685	Natural gas, petroleum, natural gas liquids, sulfur, sand and gravel.
Polk	5,692	5,798	Petroleum, natural gas.
Potter	16,212	71,139	Natural gas, natural gas liquids, helium, cement, stone, petroleum.
Presidio	W	W	Mercury.
Rains	1,661	991	Natural gas liquids, natural gas.
Randall	---------	W	Stone.
Reagan	58,015	25,076	Petroleum, natural gas liquids, natural gas.
Red River	102	94	Petroleum, natural gas.
Reeves	14,220	20,616	Natural gas, petroleum, natural gas liquids, sand and gravel.
Refugio	108,936	102,866	Petroleum, natural gas, natural gas liquids.
Roberts	8,387	8,824	Petroleum, natural gas.
Robertson	206	W	Stone, petroleum, natural gas.
Rockwall	165	104	Stone.
Runnels	13,961	11,222	Petroleum, natural gas, natural gas liquids.
Rusk	46,866	46,882	Petroleum, natural gas liquids, natural gas, clays.
Sabine	---------	4	Sand and gravel.
San Augustine	3	(2)	Petroleum, natural gas.
San Jacinto	2,721	2,351	Petroleum, sand and gravel, natural gas.
San Patricio	43,075	44,107	Petroleum, natural gas, natural gas liquids, sand and gravel stone, clays.
San Saba	21	26	Stone.
Schleicher	12,872	13,065	Petroleum, natural gas, natural gas liquids.
Scurry	146,407	152,440	Petroleum, natural gas liquids, natural gas, clays.
Shackelford	9,483	9,854	Petroleum, natural gas, natural gas liquids, sand and gravel.
Shelby	755	937	Natural gas, petroleum.
Sherman	17,191	16,848	Do.
Smith	11,950	13,386	Petroleum, natural gas, natural gas liquids, clays.
Somervell	W	W	Sand and gravel.
Starr	32,409	36,174	Petroleum, natural gas, natural gas liquids, pumicite, clays.
Stephens	8,936	7,668	Petroleum, natural gas, natural gas liquids.
Sterling	11,005	8,797	Petroleum, natural gas.
Stonewall	20,856	20,373	Petroleum, natural gas liquids, natural gas, sand and gravel.
Sutton	2,008	2,604	Petroleum, natural gas.
Tarrant	7,232	8,119	Cement, sand and gravel, stone.
Taylor	14,633	12,958	Petroleum, natural gas, natural gas liquids, stone, sand and gravel, clays.

See footnotes at end of table.

Table 2.—Value of mineral production in Texas, by counties[1]—Continued

(Thousands)

County	1967 r	1968	Minerals produced in 1968 in order of value
Terrell	$3,915	$1,987	Natural gas, sand and gravel, petroleum.
Terry	26,280	29,498	Petroleum, sodium sulfate, natural gas, natural gas liquids.
Throckmorton	6,962	6,432	Petroleum, natural gas, sand and gravel.
Titus	13,140	13,254	Petroleum, natural gas.
Tom Green	7,265	7,770	Petroleum, stone, natural gas, natural gas liquids, sand and gravel.
Travis	5,037	5,086	Lime, stone, sand and gravel, petroleum, natural gas.
Trinity	141	128	Stone, natural gas, clays, petroleum.
Tyler	3,350	3,950	Petroleum, natural gas.
Upshur	10,095	10,827	Petroleum, natural gas, sand and gravel.
Upton	60,534	83,531	Petroleum, natural gas, natural gas liquids, sand and gravel.
Uvalde	W	W	Asphalt, stone, sand and gravel, natural gas.
Val Verde	238	446	Natural gas, petroleum.
Van Zandt	35,764	38,835	Petroleum, natural gas liquids, salt, natural gas.
Victoria	32,530	25,229	Petroleum, natural gas, sand and gravel, natural gas liquids.
Walker	128	263	Natural gas, petroleum, sand and gravel, clays, stone.
Waller	34,003	44,561	Natural gas, natural gas liquids, petroleum, sand and gravel.
Ward	56,432	58,076	Petroleum, natural gas, natural gas liquids, sodium sulfate, salt, sand and gravel.
Washington	1,027	848	Petroleum, natural gas.
Webb	8,803	8,709	Petroleum, natural gas, natural gas liquids, sand and gravel, clays.
Wharton	99,472	80,768	Sulfur, petroleum, natural gas, sand and gravel, natural gas liquids.
Wheeler	11,900	9,589	Petroleum, natural gas, natural gas liquids, sand and gravel.
Wichita	33,450	29,621	Petroleum, natural gas liquids, sand and gravel, natural gas, stone.
Wilbarger	15,397	13,411	Petroleum, natural gas, natural gas liquids, sand and gravel.
Willacy	10,228	12,173	Petroleum, natural gas, natural gas liquids.
Williamson	8,082	5,419	Stone, lime, petroleum, natural gas.
Wilson	2,435	2,721	Petroleum, clays, natural gas.
Winkler	96,966	98,717	Petroleum, natural gas, natural gas liquids.
Wise	37,448	28,326	Petroleum, natural gas liquids, stone, natural gas, clays.
Wood	67,873	74,076	Petroleum, natural gas liquids, natural gas, sand and gravel, clays.
Yoakum	77,768	91,154	Petroleum, natural gas, natural gas liquids, salt.
Young	12,446	12,178	Petroleum, natural gas, natural gas liquids, sand and gravel.
Zapata	8,849	4,189	Natural gas, petroleum.
Zavala	953	1,877	Petroleum, natural gas.
Undistributed	25,783	30,901	
Total	5,406,371	5,505,831	

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties were not listed because no production was reported in 1967 or 1968: Bailey, Bandera, Castro, Coryell, Deaf Smith, Delta, Fannin, Jeff Davis, Kendall, Kinney, Parmer, Real, and Swisher.

[2] Less than ½ unit.

Table 3.—Indicators of Texas business activity

	1967	1968 p	Change (percent)
Employment and labor force, annual average:			
Total labor force ... thousands	4,269.7	4,302.8	+0.8
Unemployment ... do	123.8	117.4	—5.2
Employment:			
Construction ... do	208.4	215.3	+3.3
Mining ... do	106.0	103.1	—2.7
All manufacturing ... do	663.7	707.6	+6.6
All industries ... do	4,145.9	4,000.2	—3.5
Factory payrolls ... millions	$3,847.7	$4,408.4	+14.6
Personal income:			
Total ... do	$29,822	$33,111	+11.0
Per capita	$2,747	$3,016	+9.8
Construction activity:			
Building permits (total private nonresidential) ... millions	$600.8	$613.3	+2.1
State highway commission:			
Value of construction started ... do	$452.9	$417.5	—7.8
Value of construction completed ... do	$341.8	$313.2	—8.4
Cement shipments to and within Texas thousand 376-pound barrels	26,955	28,356	+5.2
Farm marketing, cash receipts ... millions	$2,522.0	$2,707.0	+7.3
Mineral production ... do	$5,406.4	$5,505.8	+1.8

p Preliminary.

Sources: Texas Employment Commission, Survey of Current Business, Construction Review, Texas Highway Department, and The Farm Income Situation.

The varied metals-extractive industry at Texas in 1968 consisted of 16 plants; namely, three aluminum-reduction works, one antimony smelter, one copper smelter, one copper refinery, two iron blast furnaces, one lead smelter, two magnesium-reduction plants, one tin-tungsten smelter, one manganese alloy plant, and three zinc smelters. Cadmium, rare-earth metals, zinc oxide, and precious metals were also recovered in special units associated with existing smelting facilities.

There were 20 secondary metal recovery plants which processed various types of scrap and other secondary materials to recover aluminum, lead, iron and steel, tin, and zinc.

Important mineral industry developments during 1968 included the following: The Texas Railroad Commission changed two World War II orders pertaining to allowables in the East Texas field. A ceiling was placed on transfer of allowables between wells on the same lease, and the order which permitted the transfer of decline-curve allowables from one well to another on separate leases was canceled.

Two sales of State leases resulted in 15,506 acres being acquired at an average bonus of $47.48 per acre.

The State's oil industry continued to test the Smackover Formation in east Texas in 1968. Drilling targets were small closures associated with a series of well-known faults.

A billion dollar law suit by 25,000 royalty owners and lessee-producers for a share of the profits realized by helium extraction firms was denied by a U.S. District Judge. The ruling held that the price paid for gas included the helium contained in the gas stream.

Gulf Oil Corp. established a new world producing-depth record. This No. 1 "DD" Gas Unit in the Gomez field, Pecos County, produced 15 million cubic feet of gas per day from the Ellenburger Formation at depths from 21,548 to 22,752 feet.

Interest in west Texas sulfur deposits continued. A total of 504 wells totaling 482,475 feet were drilled principally to test the Seven Rivers, Castile, Salado, and Rustler Formations of Permian age in the Delaware Basin and Central Basin Platform in Pecos, Reeves, and Culberson Counties, and principally to the Leonard Formation of the Eastern Shelf in Tom Green County. Duval Corp. began installation of equipment for a 1.5-million-ton-per-year Frasch sulfur recovery operation in northeast Culberson County and expanded its Fort Stockton operation in Pecos County. Sinclair Oil and Gas Co. started expansion of its Frasch operation in Pecos County to recover 100,000 tons of sulfur per year.

Drilling activities continued in the Delaware and Val Verde Basins of Trans-Pecos region and resulted in finding substantial gas reserves. Several large gas-producing wells were completed in the Gomez field. Other large gasfields in this trend were Coyanosa, Worsham, Hamon, Waha, and the J. M. field. By late 1968, over 1 billion cubic feet of gas daily was being transported from these areas. Principal markets for the gas were the West Coast and North-Central United States. Late in 1968, a number of these deep wells were shut-in pending Federal Power Commission (FPC) approval for pipeline connections.

Underground liquefied petroleum gas (LPG) storage capacity in Texas salt domes and salt layers increased 3.2 percent to 76.3 million barrels. New storage facilities were being developed in a salt dome in Smith County (475,000 barrels) and in salt layers in Hutchinson, Moore, and Winkler Counties (170,000 barrels).

Modernization and expansion programs were continued at six oil refineries.

Consumption, Trade, and Markets.—The mineral industry of Texas processed a large portion of its raw materials into finished and semifinished products, part of which were consumed within the State. Economic advances of the mineral industry generally paralleled those of the State's industrial and business sectors, according to the Bureau of Business Research of The University of Texas at Austin.

Using 1957–59 index as 100, the total industrial production index of Texas compiled by the Bureau of Business Research, advanced 8 percent to 167.9, considerably higher than the nationwide 5-percent gain. Nearly all sectors of the State's production indexes increased. Total manufacturing rose 9 percent to 190.2; durable goods advanced 12 percent to 206.9; and nondurable goods increased 6 percent to 179.2. Some increases in the more active industries were construction, 13 percent to 181.5; total electric power, 10 percent to 226.2; and industrial electric power, 10 percent to 203.1. The mining index, which is dominated by mineral fuels, rose 4 percent.

According to the Bureau of Business Research, new construction permits totaled $1.9 billion, a 12 percent increase. Residential construction permits comprised 58 percent of total construction and set a new record of $1.1 billion, a 29-percent increase. The State's new residential units growth rate was about twice the national rate.

Nonbuilding construction in 1968 was concentrated in the utilities, sewage and water supply systems, and airport site preparation. Street and highway construction showed only modest increase due primarily to reduced Federal highway allotments.

Texas accounted for $3.6 billion of the Nation's $34.4 billion total exports and was second to New York, according to the Bureau of Census, U.S. Department of Commerce. Nondurable exports were over twice those of durable exports. Petrochemicals and refined petroleum products were export items. Other major export items were primary metals including copper, aluminum, lead, zinc, antimony, magnesium, and tin. Texas was also a major exporter of sulfur.

Legislation and Government Programs.—The Texas Railroad Commission changed two orders issued during World War II pertaining to production in the East Texas field. The transfer of decline-curve allowables from one well to another on separate leases was cancelled, and a production ceiling was set on allowable transfers between wells on the same lease in the East Texas field.

The Railroad Commission requested information on location, depth, and plugging of sulfur exploratory wells.

The U.S. Army Corps of Engineers continued a number of feasibility and economic studies on Texas waterways and continued construction of a number of dams. The $9.2 million Pat Mayse Dam and Reservoir on Sanders Creek, a tributary of the Red River, 12 miles north of Paris, Tex., was 97 percent complete and in use. The $23.8 million Somerville Dam and Reservoir on Yegua Creek, about 2 miles south of Somerville, Tex., was approximately 99 percent complete and in operation. Also 99 percent completed and in operation was the $19.9 million Stillhouse Hollow Dam and Reservoir on the Lampasas River, about 5 miles southwest of Belton. Construction was 29 percent complete on the Wallisville Dam and Reservoir of the Trinity River, about 44 miles east of Houston.

Raising the dam and providing a new spillway and outlet works was underway at Lake Kemp, a reservoir on the Wichita River about 40 miles southwest of Wichita Falls. Increasing the height and length of the existing Trinity River dam, northwest of Dallas was underway. Engineering, design, and land acquisition were started for a system of three reservoirs on the San Gabriel River in Williamson County: North Fork Reservoir, Laneport Reservoir, and South Fork Reservoir. Estimated total project cost was $65.4 million.

The 90th Congress passed and the President signed, two major waterway project bills appropriating nearly $3 billion. Project proposals for Texas included a 9-foot-deep, 200-foot-wide slack-water navigation channel on the Overton-Red River waterway from Shreveport, La., to Daingerfield, Tex. An economic restudy of the Overton-Red River waterway was recommended by the Corps of Engineers prior to any construction activity. Also, a 530-mile bank stabilization project on the Red River below Denison Dam was included.

The Amistad Dam and Reservoir project, a joint project of the U.S. International Boundary and Water Commission and the Comisión Internacional De Límites Aguas De México was over 99 percent complete at the end of 1968. The crest of the dam is 254 feet above the river bed. The dam is 6.06 miles long and consists of a 2,182-foot-long concrete gravity section in the river channel flanked by 1.61 miles of embankment on the United States side and 4.04 miles of embankment on the Mexican side. Surface areas of the reservoir will include 13,600 acres of silt storage, 67,000 acres of conservation storage, 84,000 acres of flood storage, and 88,200 acres of super storage. The damsite is 1 mile below the confluence of the Devils River and the Rio Grande River.

The Texas Water Development Board announced its "Texas Water Plan" that provides a flexible guide for the orderly development, conservation, and management of the State's water resources to meet the expanding water needs to the year 2020. The plan included possible transportation of surplus water from the Mississippi, Red, Sulphur, Sabine, and Nueces Rivers and Cypress Creek to water-deficient areas. The plan proposed full development and conservation of all State water resources to meet the rapidly expanding demands for domestic and municipal uses.

Employment and Injuries.—According to the Texas Employment Commission a record 4.4 million Texans were employed in December of 1968. Wages, likewise, reached new highs; average hourly earnings of salaried employees in manufacturing industries amounted to $2.94 and raised average weekly earnings to $124.07 as compared with the yearly average of $119.81. Nonagricultural wage and salary employment totaled 3.5 million in December 1968, a 5 percent increase from the December 1967 level. Mining employment in December 1968 was 107,500, considerably higher than the 103,100 yearly average.

During 1968 State average hours worked per week in the manufacturing industry remained unchanged at 41.6, while the work week for mining employees advanced from 42.7 to 43.0 hours. The work week of employees in crude petroleum and natural gas advanced from 42.5 to 42.9 hours.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	102	274	28	224	-------	3	13.42	282
Metal	1,571	306	481	3,852	1	54	14.28	2,343
Nonmetal and native asphalt	3,316	293	970	7,859	3	170	22.01	2,789
Sand and gravel	2,117	264	559	5,126	1	155	30.43	2,111
Stone	4,604	312	1,436	12,052	3	211	17.76	1,959
Total [1]	11,710	297	3,475	29,112	8	593	20.64	2,248
1968: [p]								
Coal	115	269	32	252	-------	4	15.85	333
Metal	1,705	282	481	3,849	-------	32	8.31	594
Nonmetal and native asphalt	3,075	289	913	7,394	-------	176	23.80	1,057
Sand and gravel	2,050	260	533	4,887	4	119	25.17	5,362
Stone	4,485	309	1,386	11,677	1	221	19.01	1,225
Total [1]	11,435	290	3,345	28,060	5	552	19.85	1,807

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Table 5.—Employment data in mining and related industries

(Thousand employees)

Industry	Employment		Weekly hours worked		Weekly earnings	
	1967	1968	1967	1968	1967	1968
Manufacturing	663.7	707.6	41.6	41.6	111.49	119.81
Primary metals	32.3	32.3	41.4	42.0	128.75	138.60
Stone, clay, and glass products	27.5	28.7	42.2	42.4	95.79	106.00
Chemicals	59.6	61.5	42.2	38.1	149.39	156.40
Petroleum and related industries	36.0	36.7	42.5	42.9	159.80	167.31
Transportation equipment	81.3	98.4	42.3	42.4	140.01	148.40
Nonmanufacturing	2,606.7	2,704.4	------	------	------	------
Mining	106.0	103.1	42.7	43.0	137.07	147.06
Crude petroleum and natural gas	99.7	96.8	42.5	42.9	138.55	149.29
Other mining	6.3	6.3	------	------	------	------
Construction	208.4	215.3	------	------	------	------

Source: Texas Employment Commission; U.S. Bureau of Labor Statistics.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The value of mineral fuels increased 1.8 percent and remained the principal contributor to the State's mineral economy. Crude oil contributed about 68.5 percent of the fuels value, natural gas 20.1 percent, natural gas liquids about 10.9 percent, and helium and lignite accounted for the remainder. The State's oil production pattern varied considerably from that of 1967. The January 1968 market-demand factor was 45.7 percent as compared with 40.8 percent for November and December of 1967. The market-demand factor for February and March was 49.6 percent. The factor was lowered irregularly to 41.3 percent for September, at which point it remained until yearend. Oil production was 1.2 percent higher than 1967. One reason for increased demand for Texas crude was the failure to reopen the Suez Canal in 1968. Some Texas oil production was sent to the European market which had been cut off from its normal Middle East oil supplies.

Table 6.—Production and value of mineral fuels

Year	Crude petroleum		Natural gas [1]	
	Thousand 42-gallon barrels	Value (thousands)	Million cubic feet	Value (thousands)
1964	989,525	$2,928,994	6,490,202	$809,180
1965	1,000,749	2,962,119	6,636,555	858,396
1966	1,057,706	3,141,387	6,953,790	903,993
1967	1,119,962	3,375,565	7,188,900	948,935
1968	1,133,380	3,450,707	7,495,414	1,011,881

Year	Natural gas liquids					
	Natural gasoline and cycle products		LP gas		Total	
	Thousand 42-gallon barrels	Value (thousands)	Thousand 42-gallon barrels	Value (thousands)	Thousand 42-gallon barrels	Value (thousands)
1964	83,630	$232,245	131,458	$167,492	215,088	$399,737
1965	89,821	256,959	139,229	204,666	229,050	461,625
1966	92,625	269,332	151,425	260,755	244,050	530,087
1967	95,991	277,105	177,367	320,326	273,358	597,431
1968	97,075	269,182	189,162	278,068	286,237	547,250

[1] Marketed production, gas either sold or consumed by producers including losses in transmission, amounts added to storage, and increases in gas pipelines.

Table 7.—Production trends of crude oil, natural gas, and natural gas liquids

(Million barrels of oil equivalent)

Year	Production [1]				Percentage of—						
					Annual total			Change of reported year			
	Oil	Gas	Liquids	Total	Oil	Gas	Liquids	Oil	Gas	Liquids	Total
1964	990	1,159	157	2,306	42.9	50.3	6.8	1.2	4.6	4.0	3.1
1965	1,001	1,185	168	2,354	42.5	50.4	7.1	1.1	2.2	7.0	2.1
1966	1,058	1,242	179	2,479	42.7	50.1	7.2	5.7	4.8	6.5	5.3
1967	1,120	1,284	199	2,603	43.0	49.3	7.7	5.9	3.4	11.2	5.0
1968	1,133	1,338	208	2,679	42.3	49.9	7.8	1.2	4.2	4.5	2.9

[1] One barrel of crude oil equivalent to 5,600 cubic feet of natural gas or 57.6 gallons of natural gas liquids, a composite of 52.7 gallons of natural gasoline and 60.8 gallons of LP gases.

Table 8.—Comparison of mineral fuels production in Texas and the United States

Fuel	Production[1] as oil equivalent				Change from 1967 (percent)		Percent of fuels				Texas percent of United States	
	Texas		United States				Texas		United States			
	1967	1968	1967	1968	Texas	United States	1967	1968	1967	1968	1967	1968
Crude oil	1,120	1,133	3,216	3,329	+1.2	+3.5	43.0	42.3	47.0	46.4	34.8	34.0
Natural gas	1,284	1,338	3,245	3,450	+4.2	+6.3	49.3	49.9	47.5	48.0	39.6	38.8
Natural gas liquids	199	208	375	401	+4.5	+6.9	7.7	7.8	5.5	5.6	53.1	51.9
Total equivalent	2,603	2,679	6,836	7,180	+2.9	+5.0	100.0	100.0	100.0	100.0	38.1	37.3

[1] Million barrels of oil equivalent, derived by gas and liquids factors reported in table 7.

Table 9.—Fuels reserves ratio to production in Texas and the United States

Fuel	Reserves[1]				Percent—				Reserve ratio			
	Texas		United States		Texas of United States		Change from 1967		Texas		United States	
	1967	1968	1967	1968	1967	1968	Texas	United States	1967	1968	1967	1968
Crude oil	14,494	13,810	31,377	30,707	46.2	45.0	—4.7	—2.1	12.9	12.2	9.8	9.2
Natural gas	22,396	21,250	52,305	51,312	42.8	41.4	—5.1	—1.9	17.4	15.9	16.1	14.9
Natural gas liquids	2,992	2,861	6,281	6,248	47.6	45.8	—4.4	—.5	15.0	13.8	16.7	15.6
Total oil equivalent	39,882	37,921	89,963	88,267	44.3	43.0	—4.9	—1.9	15.3	14.2	13.2	12.3

[1] Million barrels of oil equivalent, derived by gas and liquids factors reported in table 7.

A total of 7,610 exploratory and developmental holes were drilled according to The American Association of Petroleum Geologists, Inc. (AAPG). The industry completed 4,539 ventures as oil and gas wells and abandoned 3,071 ventures as dry holes. Exploratory drilling resulted in 236 oil discoveries and 145 gas discoveries; 1,782 holes were dry and abandoned. Developmental drilling totaled 5,447 holes and resulted in 3,541 oil wells, 617 gas wells, and 1,289 dry holes.

The Texas Railroad Commission received or approved several thermal-recovery applications. Noteworthy applications included Shell Oil Co.'s plan to expand a pilot steam flood in the Wilcox-Carrizo sand of the Slocum field in Anderson County. Sun Oil Co., DX Division, applied to start three "subpilot" fire floods in three zones in the Trix-Liz field, Titus County. The company estimated that its leases originally contained 16 million barrels of oil, and less than 1.2 million barrels had been produced by primary means. The company believes that these projects could recover an additional 3.2 million barrels of oil. Sun Oil Co. estimated that 3.9 million barrels of oil was recoverable from the Glen Hummel field, Wilson County, by thermal methods. Union Texas Petroleum Co. applied to install a fireflood in the Massie West field, Val Verde County. Kimball Production Co. applied to start a steam flood in the Camp Hill field, Anderson County. The company estimated a successful steam drive could recover an additional 3.7 million barrels of oil.

Pipelines.—The oil and gas industry continued to enlarge its Texas pipeline systems in 1968. The year saw significant increased natural gas takes from the Delaware-Val Verde Basin area and a change in crude-oil movement from west Texas oilfields. Natural gas deliveries from the Delaware-Val Verde fields rocketed from next to nothing to nearly 1 billion cubic feet per day in the span of 5 years. Approval of interstate pipeline applications submitted to the FPC by El Paso Natural Gas Co., Northern Natural Gas Co., Transwestern Pipe Line Co., and National Gas Pipe Line Co. of America could increase gas deliveries by

Table 10.—Estimated proved recoverable reserves of natural gas, natural gas liquids, and crude oil in 1968 by railroad districts

Railroad district	Proved reserves, Dec. 31, 1967	Extensions and revisions	New fields and new pools	Production	Proved reserves, Dec. 31, 1968 [1]	Change from Dec. 31, 1967 [1]
NATURAL GAS [2] (MILLION CUBIC FEET)						
1	2,429,936	—50,512	6,881	140,394	2,245,944	—183,992
2	11,739,786	—359,923	80,177	686,245	10,774,613	—965,173
3	26,946,816	—188,236	245,954	1,483,072	25,529,462	—1,417,354
4	32,905,785	+547,078	421,551	1,504,068	32,370,346	—535,439
5	1,451,981	—17,572	37,316	121,689	1,347,687	—104,294
6	6,519,607	+209,109	38,835	428,129	6,339,422	—180,185
7B	747,870	+114,593	12,710	99,692	774,066	+26,196
7C	3,894,530	+158,571	61,582	197,521	3,917,013	+22,483
8	19,458,263	—113,324	203,245	1,110,119	18,438,065	—1,020,198
8A	3,454,504	—15,006	1,551	195,374	3,245,675	—208,829
9	2,695,677	—283,709	6,443	175,463	2,243,361	—452,316
10	13,170,309	—349,092	56,154	1,102,208	11,775,452	—1,394,857
Total	125,415,064	—348,023	1,172,399	7,243,974	119,001,106	—6,413,958
NATURAL GAS LIQUIDS [3] (THOUSAND BARRELS)						
1	38,250	+86	56	3,298	35,094	—3,156
2	179,714	—5,425	962	15,812	159,439	—20,275
3	864,607	—5,362	3,821	59,489	803,577	—61,030
4	761,518	+12,594	8,493	61,493	721,112	—40,406
5	91,015	—2,565	568	6,981	82,037	—8,978
6	484,327	+8,265	624	24,696	468,520	—15,807
7B	32,450	+18,264	349	6,733	44,330	+11,880
7C	174,668	+2,188	3,518	18,107	162,267	—12,401
8	645,878	+18,872	2,207	61,615	605,342	—40,536
8A	380,481	—9,540	32	19,877	351,096	—29,385
9	64,258	+18,969	334	7,745	75,816	+11,558
10	385,829	+148,880	2,390	40,356	496,743	+110,914
Total	4,102,995	+205,226	23,354	326,202	4,005,373	—97,622
CRUDE OIL [4] (THOUSAND BARRELS)						
1	159,435	+6,579	953	17,094	149,873	—9,562
2	966,419	+2,805	5,055	64,078	910,201	—56,218
3	2,045,281	+28,258	4,800	142,474	1,935,865	—109,416
4	691,578	+25,198	8,390	85,971	639,195	—52,383
5	155,030	+5,297	476	12,243	148,560	—6,470
6	2,764,640	+21,667	2,416	108,791	2,679,932	—84,708
7B	263,884	+11,634	1,860	36,636	240,742	—23,142
7C	382,133	+23,457	3,922	48,329	361,183	—20,950
8	3,629,496	+30,383	9,052	275,100	3,393,831	—235,665
8A	2,728,129	+181,272	2,609	186,517	2,725,493	—2,636
9	432,614	—8,139	1,841	60,070	366,246	—66,368
10	275,470	+14,338	600	31,623	258,785	—16,685
Total	14,494,109	+342,749	41,974	1,068,926	13,809,906	—684,203

[1] Change reflects production and net additions and withdrawals in storage.

[2] Committee on Natural Gas Reserves of American Gas Association.

[3] Committees on Natural Gas Liquid Reserves of American Petroleum Institute and American Gas Association.

[4] Committees on Crude Oil Reserves of the American Petroleum Institute and American Gas Association.

some 740 MMcfd. Interstate pipelines, which do not need FPC approval, have contracted for nearly 600 million cubic feet per day.

Other important natural gas pipeline projects include the following: A 100-mile, 30-inch line from Coastal States Gas Producing Co. facilities to Texas Power and Light Co.'s station near Waco; a 34-mile, 24-inch line from Upton County line to El Paso Natural Gas Co.'s Goldsmith plant; and a 143-mile, 30-inch line from El Paso Natural Gas Co.'s Waha plant to its Cornudas plant. Lone Star Gas Co. completed a 22-mile, 12-inch line from Henderson County to its main transmission line to the Dallas-Fort Worth metropolitan area. Lo-Vaca Gathering Co. was building a 265-mile, 30-inch line from the Grey Ranch gas area in Pecos County to the San Antonio area and a 40-mile, 30-inch line from the Grey Ranch, Pecos County area, to the Gomez field. Pan American Gas Co. was building a 16-mile, 8-inch line; a 20-mile, 6-inch line; and a 5-mile, 4-inch line from the Trinidad, Northwest gasfield in Henderson County to its pipeline in Van Zandt County. United Gas Pipe Line Co. completed a 104-mile, 30-inch line from its North Houston loop in Waller County to its gathering line in Liberty County. The company was building a 15-mile, 6-inch line from the Lavelle gasfield to a 6-inch Huntsville line at Crockett, Houston County.

Gulf Oil Corp. was building a 62-mile, 10-inch products line from Port Arthur to Mont Belvieu. Humble Pipe Line Co. was building five 18-mile lines; three 8-inch, one 6-inch, and one 4-inch lines in the Houston metropolitan area; and a 45-mile, 6- and 8-inch products line from Anahuac to Bayport. Sinclair Pipe Line Co. completed a 12-mile, 8-inch products line from Arlington to Irving. Pan American Gas Co. was building a 33-mile, 4- and 8-inch, and an 8-mile, 3-inch products line from the Trinidad, Northwest field to its Edgewood processing plant in Van Zandt County.

Asphalt (Native).—Uvalde County supplied all of the native asphalt. Production was slightly smaller in 1968 than in 1967. Most of the output was used in highway maintenance.

Carbon Black.—Carbon black production in 1968 amounted to 1,426 million pounds, an increase of 212 million pounds or 17.4 percent more than in 1967. The rubber industry remained the State's largest market for carbon black. Texas' share of U.S. production increased to 50.7 percent. There were 14 furnace and three channel plants and one combination furnace-channel plant operating in 13 counties. Furnace black amounted to 1,308 million pounds, or 92 percent of the State's total production, with high abrasion furnace and intermediate abrasion furnace grades accounting for nearly half of the output. Production of channel black amounted to 118 million pounds, 8 percent of State production. Statewide, the average carbon black yield from natural gas was 1.43 pounds per thousand cubic feet (Mcf), and average yield from 282 million gallons of liquid hydrocarbons was 4.76 pounds per gallon.

Phillips Petroleum Co. was increasing capacity of its Borger plant by 28 million pounds to a total capacity of 318 million pounds per year—the world's largest. The company also was adding 5 million pounds capacity to a 90-million-pound-per-year unit at its Orange facility. J. M. Huber Corp. completed expansion at its Borger carbon black plant.

Coal (Lignite).—Texas Utilities Co. was constructing a 1.1-megawatt generating plant in Freestone County. The plant will be fueled with lignite. Deposits of lignite in Freestone and Limestone Counties will supply the 5-million-ton-per-year demand of the plant.

Lignite was mined in Milam and Harrison Counties by two producers in 1968. Although most of the production was used as a fuel for electric power generation, a significant quantity was processed into activated carbon.

Helium.—Five helium extraction plants were operated in Texas. Two of these plants are owned and operated by the Bureau of Mines; two are owned by Phillips Petroleum Co. and produce helium for sale to the Bureau; and one is owned by the Linde Division of Union Carbide Corp. and produces helium for sale to the private sector of the market.

The two Bureau of Mines plants, at Amarillo and Exell, sold a combined total of 213.1 million cubic feet (MMcf) of Grade-A helium, valued at $7.5 million, at a price of $35 per Mcf. In addition to the helium sold, the Exell plant produced 119 MMcf valued at $1.1 million, for storage in connection with the Government's conservation program. The total helium production at the two plants was 332.1 MMcf compared with the 1967 production of 334.5 MMcf.

The two plants owned by Phillips Petroleum Co., in Moore and Hansford Counties, produced 1,038.7 MMcf of crude helium, an increase of 61 MMcf. This helium was purchased by the Bureau of Mines for $11.1 million for storage in Cliffside field, Potter County, Tex., for conservation purposes.

The Linde plant at Amarillo processed crude helium purchased from other helium processors for purification and/or liquefaction. Estimated plant production was 30 MMcf of Grade-A helium. This plant produced only about 1.4 MMcf of Grade-A helium in 1967.

Natural Gas.—Texas continued to be the leading natural gas producing State and supplied 39 percent of the total domestic output. The marketed production of natural gas amounted to 7,495 billion cubic feet (MMMcf), up 4.3 percent over 1967. Natural gas production was reported from 205 of the State's 254 counties; 22 counties had production exceeding 100 MMMcf. The 10 principal producing counties accounted for 38.6 percent of the State total, and output in MMMcf were Potter, 471.6; Pecos, 420.2; Kleberg, 392.5; Nueces, 296.0; Brazoria, 253.3; Matagorda, 249.1; Ector, 232.8; Hidalgo, 196.1; Jim Wells, 194.9; and Waller, 187.5.

During December 1968, the 23,805 producing gas wells in Texas had a total average production of 319 MMcf daily, a 2.3-percent increase in production from 1967 levels, according to the Texas Railroad Commission. The average wellhead price was 13.5 cents per Mcf, an increase from 13.2 cents per Mcf in 1967.

The oil and gas industry of Texas completed 762 gas wells in 1968, of which 145 were exploratory completions and 617 were developmental wells, according to the AAPG.

Exploratory operations for gas continued in the Delaware and Val Verde Basins of west Texas, Railroad Commission (RRC) Districts 7C, 8, and 8A. Important natural gas reserves were discovered in Ellenburger and Devonian Formations in Crockett, Pecos, Reeves, Terrell, Ward and Winkler Counties. Some of these findings were as follows: A 54-MMcfd Ellenburger discovery in Terrell County by Pan American Petroleum Corp., a 14-MMcfd Simpson gas discovery by Chambers and Kennedy in Crockett County; and 27-MMcfd Ellenburger and 150-MMcfd Atoka gas discoveries in Winkler County. There were two important gas discoveries in Pecos County—an 85-MMcfd Devonian producer by H. W. Bass and Sons, Inc., and a 20-MMcfd Montoya producer by Humble Oil & Refining Co. Texaco Inc., recorded a 37-MMcfd Devonian discovery in Reeves County.

In south Texas (RRC Districts 1, 2, and 4) exploratory drilling resulted in six significant gas discoveries—two Wilcox discoveries in De Witt and McMullen Counties, two Frio discoveries in Aransas and Nueces Counties, a Vicksburg in Hidalgo County, and an Olmos in Dimmit County.

Exploratory activity in east Texas (RRC Districts 5 and 6) resulted in five gas discoveries. Limestone County had one Cotton Valley Formation gas discovery. Both Henderson County and Freestone County had two gas discoveries.

In the Texas Upper Gulf Coast (RRC District 3) there were 16 gas discoveries. Harris County was the leader with three; Matagorda, San Jacinto, and Wharton Counties had two; and single discoveries were reported for Brazoria, Colorado, Jefferson, Liberty, Orange, Tyler, and Walker Counties.

According to the American Gas Association, Inc., proved natural gas reserves as of December 31, 1968, was 119,001 billion cubic feet, a decline of 6,414 billion cubic feet or 5 percent from that in 1967. The State reserve was 41 percent of the national total.

Natural Gas Liquids.—Texas was the principal producer of natural gas liquids in 1968, supplying 52.0 percent of the domestic output. Natural gas liquids output increased 540,926,000 gallons, 4.7 percent more than in 1967. Liquefied petroleum gas (LPG) production increased 6.6 percent or 495,365,000 gallons; natural gasoline and cycle products advanced 1.1 percent or 45,561,000 gallons. Value of the combined liquids declined 8.4 percent to $547.3 million. Value of LPG declined 13.2 percent, and value of natural gasoline and cycle products declined 2.9 percent. The unit value for LPG declined from 4.30 cents per gallon in 1967 to 3.50 cents per gallon. The unit value of natural gasoline and cycle products declined from 6.87 to 6.60 cents per gallon. These value trends reflected an oversupply condition of the natural gas liquid industry, particularly that of LPG.

There were 405 natural gasoline and cycle plants in Texas—43 cycle plants and 362 natural gasoline plants—according to the Texas Railroad Commission. Installed capacity was reported at 28.7 MMMcfd, a 270.6-MMcfd increase from 1967 capacity.

Proved natural gas liquid reserves was 4,005,373,000 barrels on December 31, 1968, according to the American Gas Association, Inc.—a decline of 97,622,000 barrels or 2.4 percent. Texas accounted for nearly 47 percent of the 1968 national proved reserve.

The industry continued to build, expand, and modernize gas processing plants during 1968. One of the world's largest natural gas liquids extraction plants, designed to process 1,034 MMcf of natural gas and recover over 900,000 gallons of liquids per day, was put into operation by Phillips Petroleum Co. and Houston Natural Gas Corp. at Alvin, Tex. Outstanding features of the plant include high natural gas throughput and high recovery of both ethane and natural gas liquids. Cities Service Oil Co. began operating a new cryogenic gas-processing plant near Waco, Tex. Product recovery is obtained entirely by refrigeration. Pan American Gas Co. constructed a cryogenic plant that operates at about −150° F at Texas City, Galveston County. The low temperatures are obtained by decreasing gas inlet pressure from 600 to 200 pounds per square inch. The plant processes 140 MMcfd of gas to recover 2,700 barrels per day of ethane-propane mix and 500 barrels per day of butane-gasoline. Southern Minerals Corp. completed a 75-MMcfd gas-processing plant in Corpus Christi.

Cities Service Oil Co. expanded throughput at its Roberts Ranch gasoline plant in Midland County to 85 MMcfd. Propane recovery was increased to 150,000 gallons per day, and combined liquids recovery was increased to 125,000 gallons per day.

Cities Service Oil Co. started construction on a 22.7-MMcfd gas-processing plant at Myrtle Springs, Van Zandt County. Planned daily recovery is 15,000 gallons of propane, 15,500 gallons of butane, 6,500 gallons of debutanized natural gasolines, and 200 long tons of sulfur. Coastal States Gas Producing Co. completed a 100-MMcfd expansion at its Corpus Christi refrigerated-absorption gas plant which will increase liquid ethane recovery to 125,000 gallons per day. Colorado Interstate Gas Co. added a 90,000-gallon-per-day LPG unit to its Bivins plant in Moore County. Getty Oil Company completed fractionation units to increase liquid recovery by 84,000 gallons per day at its Headlee Devonian plant in Ector County.

Humble Oil & Refining Co. expanded the following gasoline plants: Anahuac, Chambers County; Conroe, Montgomery County; Tomball, Harris County; Neches, Cherokee County; Katy, Waller County; Clear Lake, Harris County; Hawkins, Wood County; and Lovell Lake, Jefferson County. Humble also completed a new 13-MMcfd adsorption plant at its Pita unit in Brooks County to recover 8,650 gallons per day of combined liquids, and was building a new 25-MMcfd adsorption plant at Thompson, Tex., to recover 17,000 gallons per day of gasoline.

Intrastate Gathering Corp. completed a 38-MMcfd gasoline plant at Rio Grande City in Starr County to recover 23,000 gallons per day of liquids. Mapco Production Co. was building a 50-MMcfd refrigerated-absorption unit at its Westpan unit near Fritch in Hutchinson County. The unit will recover 75,000 gallons per day of combined liquids. Mobil Oil Corp. added a refrigeration unit to its Seeligson plant in Jim Wells County to recover an additional 3,600 barrels per day of ethane. Northern Natural Gas Co. added a 35.0-MMcfd refrigeration-absorption unit to its Pecos County plant to increase combined liquid recovery by 10,000 gallons per day.

Pan American Petroleum Corp. added 7-MMcfd throughput capacity to its gasoline plant in the Anton Irish field in Hale and Lamb Counties to increase combined liquid production by 25,000 gallons per day. Shell Oil Co. added 26.0-MMcfd refrigeration-absorption capacity to its Tippet plant in Crockett County to recover 51,000 gallons per day of propane, 49,000 gallons per day of butane and heavier liquids; and added 100.0-MMcfd refrigeration-absorption capacity to its Wasson gasoline plant in Yoakum County. The new units will increase total propane recovery to 140,000 gallons per day and butane and heavier liquids to 150,000 gallons per day. Standard Oil Co. of Texas completed a 3-MMcfd throughput expansion at its Sherman plant in Grayson County to raise propane recovery 6,600 gallons per day. Sun Oil Co. completed a new 15.0-MMcfd refrigeration-absorption gasoline plant at East Laketon in Gray County to recover 25,200 gallons per day of combined liquids.

Texaco Inc., completed three new gasoline plants during 1968—a 17-MMcfd unit at its Encinitas facility in Brooks County to recover 24,000 gallons per day of combined liquids, a 50-MMcfd unit at its Lolita plant in Jackson County to recover 60,000 gallons per day of combined liquids, and a 20-MMcfd refrigeration-absorption unit at its Coyanosa gas plant in Pecos County to recover 35,000 gallons per day of combined liquids. The company converted its Fuller gasoline plant in Scurry County from absorption to refrigerated-absorption, and increased daily recovery to 23,000 gallons of propane, 4,500 gallons of butane, and 1,000 gallons of natural gasolines. The company also expanded its Kermit plant in Winkler County by 16 MMcfd, and increased LPG recovery 16,000 gallons per day. Warren Petroleum Corp. added an 80-long-ton-per-day sulfur unit to its Sand Hills plant in Crane County, Tex. Texas Oil and Gas Corp. built a 50-MMcf absorption plant in Jackson County and a 20-MMcf refrigeration-absorption plant in Pecos County.

Petroleum.—Crude oil production totaled 1,133,380,000 barrels, a 13,418,000-barrel increase from the 1967 totals. Price increases resulted in an average price of $3.04 per barrel as compared with $3.01 per barrel in 1967.

Crude oil production was reported from 202 counties. The leading counties in decending order were Andrews, Ector, Crane, Scurry, Gregg, Gaines, Refugio, Yoakum, Winkler, and Kleberg. Andrews and Ector Counties produced more than 50 million barrels each; Crane, Scurry, and Gregg produced more than 40 million barrels; and Gaines County produced more than 30 million barrels. Oil production from 97 counties was between 1 and 10 million barrels, and less than 1 million barrels was produced in 74 counties. There were 205,011 producing oil wells and 8,744 oilfields reporting production to the Texas RRC at the end of 1968.

According to the AAPG, exploratory drilling resulted in 236 oil discoveries. Developmental drilling resulted in 3,541 oil well completions.

Table 11.—Oil and gas drilling in 1968, by counties

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Anderson	6	1	1	1	--------	15	24
Andrews	84	1	10	3	--------	6	104
Angelina	--------	--------	--------	--------	--------	2	2
Aransas	4	3	3	5	2	2	19
Archer	79	--------	50	--------	--------	8	137
Armstrong	--------	--------	--------	--------	--------	1	1
Atascosa	6	--------	1	--------	--------	10	17
Austin	--------	--------	2	--------	--------	1	3
Bailey	--------	--------	--------	--------	--------	3	3
Bandera	--------	--------	--------	--------	--------	1	1
Bastrop	--------	--------	--------	--------	--------	1	1
Baylor	8	--------	6	--------	--------	6	20
Bee	9	5	9	--------	2	22	47
Bexar	16	--------	3	--------	--------	1	20
Borden	6	--------	2	3	--------	4	15
Bowie	--------	1	--------	--------	--------	4	5
Brazoria	40	2	13	--------	1	12	68
Brazos	3	2	--------	1	--------	--------	6
Brewster	--------	--------	--------	--------	--------	1	1
Briscoe	--------	--------	--------	--------	--------	2	2
Brooks	7	2	3	1	2	9	24
Brown	11	5	7	--------	1	7	31
Burleson	1	--------	--------	--------	--------	3	4
Caldwell	45	--------	7	--------	--------	4	56
Calhoun	11	11	10	--------	2	20	54
Callahan	35	3	30	1	--------	19	88
Cameron	--------	--------	--------	--------	1	4	5
Camp	--------	--------	1	--------	--------	3	4
Carson	31	4	2	--------	--------	--------	37
Cass	--------	--------	1	1	--------	6	8
Chambers	14	1	8	1	--------	33	57
Cherokee	--------	1	--------	--------	1	12	14
Childress	--------	--------	1	--------	--------	4	5
Clay	67	1	28	1	1	14	112
Cochran	60	--------	3	--------	--------	4	67
Coke	4	--------	5	4	--------	8	21
Coleman	12	1	8	--------	--------	9	30
Collingsworth	--------	--------	3	--------	--------	1	4
Colorado	5	15	3	1	1	11	36
Comanche	2	--------	--------	--------	--------	--------	2

Table 11.—Oil and gas drilling in 1968, by counties—Continued

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Concho	2	--------	1	--------	2	8	13
Cooke	56	--------	38	1	--------	20	115
Cottle	--------	--------	--------	1	--------	2	3
Crane	118	1	27	8	2	23	179
Crockett	43	46	15	8	4	17	133
Culberson	6	1	3	--------	--------	5	15
Dawson	46	--------	5	1	--------	7	59
Denton	--------	1	1	--------	--------	4	6
DeWitt	--------	3	4	--------	4	17	28
Dickens	--------	--------	1	--------	--------	1	2
Dimmit	1	1	2	1	2	10	17
Donley	--------	--------	--------	--------	--------	3	3
Duval	14	8	12	5	1	30	70
Eastland	9	4	5	--------	--------	3	21
Ector	96	3	5	1	--------	3	108
Ellis	--------	--------	1	--------	--------	--------	1
Erath	3	--------	2	--------	--------	--------	5
Falls	11	--------	--------	1	--------	4	16
Fayette	1	--------	2	--------	--------	--------	3
Fisher	2	--------	--------	3	--------	13	18
Floyd	--------	--------	--------	--------	--------	1	1
Foard	--------	--------	4	1	--------	5	10
Fort Bend	19	4	9	--------	--------	3	35
Franklin	16	--------	--------	--------	--------	4	20
Freestone	--------	3	1	--------	2	5	11
Frio	1	--------	--------	1	--------	5	7
Gaines	16	1	7	--------	--------	6	30
Galveston	16	1	2	--------	--------	8	27
Garza	10	--------	1	--------	--------	8	19
Glasscock	19	--------	3	2	--------	11	35
Goliad	11	4	3	--------	2	16	36
Gonzales	--------	--------	--------	--------	--------	7	7
Gray	26	2	5	--------	1	5	39
Grayson	16	--------	2	--------	--------	13	31
Gregg	7	5	--------	--------	--------	--------	12
Grimes	4	--------	1	1	--------	5	11
Guadalupe	47	--------	5	--------	--------	4	56
Hamilton	--------	--------	--------	--------	--------	2	2
Hansford	--------	10	3	--------	2	3	18
Hardeman	--------	--------	5	--------	--------	8	13
Hardin	24	1	16	2	--------	18	61
Harris	17	5	15	1	3	3	44
Harrison	8	16	--------	--------	1	6	31
Hartley	--------	--------	--------	--------	--------	2	2
Haskell	15	--------	13	1	1	31	61
Hemphill	4	4	5	2	1	1	17
Henderson	1	2	1	1	2	7	14
Hidalgo	1	11	2	--------	3	8	25
Hill	--------	--------	--------	--------	--------	1	1
Hockley	56	--------	5	2	--------	7	70
Hood	--------	--------	--------	--------	--------	1	1
Hopkins	10	--------	3	--------	--------	15	28
Houston	12	--------	1	--------	--------	13	26
Howard	77	--------	8	2	--------	9	96
Hudspeth	--------	--------	--------	--------	--------	1	1
Hunt	--------	--------	--------	--------	--------	5	5
Hutchinson	15	6	2	1	1	3	28
Irion	17	--------	8	4	--------	11	40
Jack	73	20	22	2	1	11	129
Jackson	30	16	15	4	8	26	99
Jasper	6	--------	2	1	--------	12	21
Jeff Davis	--------	--------	--------	--------	--------	1	1
Jefferson	29	5	12	2	1	14	63
Jim Hogg	4	1	4	4	1	16	30
Jim Wells	4	1	2	--------	1	3	11
Jones	15	--------	13	--------	--------	13	41
Karnes	9	2	5	--------	--------	12	28
Kaufman	--------	--------	1	1	--------	12	14
Kenedy	7	6	4	--------	1	6	24
Kent	7	--------	7	1	--------	7	22
Kerr	--------	--------	--------	--------	--------	3	3
Kimble	--------	--------	--------	--------	--------	3	3
King	10	--------	4	--------	--------	6	20
Kleberg	17	10	5	--------	2	7	41
Knox	7	--------	8	--------	--------	11	26
Lamb	--------	--------	--------	--------	--------	4	4

Table 11.—Oil and gas drilling in 1968, by counties—Continued

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
La Salle	--------	1	--------	--------	--------	8	9
Lavaca	4	5	4	--------	3	6	22
Lee	--------	--------	--------	--------	--------	2	2
Leon	4	1	--------	--------	--------	3	8
Liberty	125	1	54	2	1	22	205
Limestone	--------	3	1	--------	1	10	15
Lipscomb	16	14	14	3	1	5	53
Live Oak	7	4	12	1	3	34	61
Loving	1	--------	1	--------	1	6	9
Lubbock	5	--------	1	--------	--------	4	10
Lynn	1	--------	2	--------	--------	4	7
McCulloch	1	--------	--------	--------	--------	--------	1
McLennan	--------	--------	--------	--------	--------	1	1
McMullen	3	2	--------	1	2	10	18
Madison	7	--------	--------	1	--------	4	12
Marion	27	2	7	3	3	8	50
Martin	37	--------	1	4	--------	1	43
Matagorda	8	3	7	2	2	15	37
Maverick	80	--------	11	--------	--------	1	92
Medina	1	--------	--------	--------	--------	--------	1
Menard	10	1	3	1	--------	5	20
Midland	24	6	--------	1	1	--------	32
Milam	2	--------	6	--------	--------	6	14
Mills	--------	--------	--------	--------	--------	1	1
Mitchell	7	--------	1	1	--------	7	16
Montague	33	--------	18	4	--------	13	68
Montgomery	--------	1	1	--------	--------	4	6
Moore	4	4	--------	1	--------	--------	9
Morris	--------	--------	--------	--------	--------	2	2
Motley	--------	--------	--------	--------	--------	1	1
Nacogdoches	12	2	3	1	--------	13	31
Navarro	3	--------	3	--------	--------	10	16
Newton	5	1	3	2	--------	13	24
Nolan	27	4	17	1	--------	10	59
Nueces	27	22	28	3	8	28	116
Ochiltree	57	4	--------	2	1	2	66
Orange	4	1	4	--------	1	10	20
Palo Pinto	5	19	4	2	3	7	40
Panola	1	9	6	1	--------	2	19
Parker	2	7	--------	--------	--------	--------	9
Pecos	45	30	24	7	5	37	148
Polk	6	--------	1	3	--------	2	12
Potter	2	13	1	--------	--------	--------	16
Presidio	--------	--------	--------	--------	--------	1	1
Rains	--------	--------	--------	--------	--------	4	4
Reagan	141	--------	1	2	--------	4	148
Red River	--------	--------	1	--------	--------	9	10
Reeves	4	11	6	1	1	11	34
Refugio	13	11	6	--------	--------	11	41
Roberts	11	3	5	2	--------	6	27
Robertson	--------	--------	--------	--------	--------	3	3
Runnels	22	--------	9	5	1	51	88
Rusk	46	3	1	--------	--------	3	53
Sabine	--------	--------	--------	--------	--------	3	3
San Augustine	--------	--------	--------	--------	--------	1	1
San Jacinto	--------	--------	1	--------	2	5	8
San Patricio	9	10	19	4	3	24	69
Schleicher	4	14	4	4	1	13	40
Scurry	17	--------	1	1	--------	8	27
Shackelford	66	1	43	29	--------	15	154
Shelby	--------	1	--------	--------	1	1	3
Sherman	--------	1	--------	--------	--------	--------	1
Smith	4	--------	1	2	--------	22	29
Starr	25	14	15	4	4	19	81
Stephens	21	3	8	2	--------	7	41
Sterling	16	1	11	4	--------	8	40
Stonewall	7	--------	9	--------	--------	22	38
Sutton	1	--------	2	--------	1	4	8
Tarrant	--------	--------	--------	--------	--------	1	1
Taylor	39	2	27	2	--------	15	85
Terrell	--------	--------	--------	--------	1	1	2
Terry	11	2	3	1	--------	4	21
Throckmorton	56	--------	42	1	--------	11	110
Titus	10	--------	1	--------	--------	5	16
Tom Green	5	--------	8	1	--------	7	21
Trinity	--------	--------	--------	--------	--------	1	1
Tyler	3	--------	1	--------	1	15	20

Table 11.—Oil and gas drilling in 1968, by counties—Continued

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Upshur	2	1	3	1	2	4	13
Upton	15	4	6	2	--------	6	33
Val Verde	--------	--------	--------	--------	--------	2	2
Van Zandt	2	2	3	--------	--------	8	15
Victoria	13	23	12	4	5	20	77
Walker	--------	1	1	--------	1	3	6
Waller	1	5	--------	--------	--------	2	8
Ward	140	11	11	4	2	11	179
Washington	1	--------	5	--------	--------	--------	6
Webb	6	21	7	1	7	52	94
Wharton	17	9	20	1	2	22	71
Wheeler	9	1	4	1	1	1	17
Wichita	214	--------	50	--------	--------	6	270
Wilbarger	41	--------	38	1	--------	6	86
Willacy	3	2	--------	--------	--------	8	13
Williamson	--------	--------	--------	--------	--------	2	2
Wilson	5	--------	3	--------	--------	18	26
Winkler	102	1	18	2	4	8	135
Wise	6	29	9	--------	--------	1	45
Wood	27	1	2	1	--------	17	48
Yoakum	64	--------	2	2	--------	4	72
Young	69	--------	47	10	--------	30	156
Zapata	5	1	2	1	--------	9	18
Zavala	5	1	2	--------	--------	10	18
Offshore area:							
High Island Area	3	1	3	3	3	7	20
Matagorda Island Area	--------	3	--------	--------	3	2	8
Galveston Area	--------	--------	--------	1	--------	5	6
Brazos Area	--------	--------	--------	--------	--------	15	15
Total	3,541	617	1,289	236	145	1,782	7,610

Source: The American Association of Petroleum Geologists, Inc.

Table 12.—Crude petroleum production, indicated demand, and stocks in 1968, by months

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Texas
January	97,834	99,414	95,180
February	94,860	95,056	94,984
March	101,261	98,124	98,121
April	95,736	91,490	102,367
May	97,742	99,413	100,696
June	93,041	92,053	101,684
July	96,879	95,771	102,792
August	97,866	99,356	101,302
September	90,363	91,006	100,659
October	92,249	93,735	99,173
November	89,389	85,737	102,825
December	86,160	88,602	100,383
Total:			
1968	1,133,380	1,129,757	XX
1967	1,119,962	1,122,414	XX

XX Not applicable.

Table 13.—Petroleum daily average production and refinery receipts

(Thousand 42-gallon barrels)

Month	1967		1968	
	Crude production	Refinery receipts	Crude production	Refinery receipts
January	3,003	2,961	3,156	3,162
February	2,977	2,960	3,271	3,227
March	2,931	2,981	3,266	3,274
April	2,891	2,853	3,191	3,093
May	2,843	2,864	3,153	3,184
June	2,908	3,052	3,101	3,179
July	3,297	3,115	3,125	3,173
August	3,458	3,205	3,157	3,119
September	3,223	3,039	3,012	3,016
October	3,147	3,206	2,975	3,029
November	3,077	3,212	2,980	2,888
December	3,047	3,288	2,930	3,068

Table 14.—Runs to stills and output of refineries in 1968, by months

(Thousand 42-gallon barrels)

Month	Runs			Output					
	Crude	Products	Rerun	Gasoline [1]	Kerosine	Fuel oil		Jet fuel	Miscellaneous
						Distillate	Residual		
January	83,254	11,914	−2,216	43,085	3,794	22,583	4,301	6,291	12,898
February	81,938	10,374	−3,704	39,448	3,677	23,245	3,429	6,279	12,530
March	84,251	10,942	−1,701	42,012	3,613	24,175	3,970	6,908	12,819
April	82,394	11,461	−2,828	41,097	3,188	20,774	3,804	7,841	14,828
May	88,636	11,643	−4,387	44,160	3,743	21,373	3,880	7,226	15,510
June	83,789	11,921	−208	44,845	3,390	21,177	4,248	6,347	15,495
July	85,038	11,472	−2,125	45,720	2,914	20,402	3,822	6,484	15,098
August	86,371	12,187	−277	46,868	3,446	21,716	3,844	6,843	15,564
September	78,395	12,635	+463	44,663	3,117	19,306	3,005	7,058	14,344
October	81,419	12,028	−1,016	45,439	3,730	18,131	3,019	7,645	14,467
November	77,160	12,382	+516	43,050	3,800	18,884	4,039	6,881	13,954
December	84,722	11,941	−439	46,382	3,933	20,563	4,537	6,797	14,012
Total:									
1968	997,367	140,900	−17,922	526,769	41,845	252,329	45,898	82,495	171,009
1967	960,895	131,557	−25,285	510,011	38,600	235,905	44,492	78,363	159,796

[1] Includes special naphthas.

Table 15.—Stocks of crude petroleum at refineries, tank farms, and gathering systems in 1968, by months

(Thousand 42-gallon barrels)

Month	Refineries	Tank farms and pipelines	Lease tanks	Total
January	15,420	60,729	7,548	83,697
February	13,501	60,856	7,428	81,785
March	15,949	61,726	7,732	85,407
April	15,475	65,356	6,972	87,803
May	15,008	65,526	6,780	87,314
June	15,736	66,320	7,056	89,112
July	16,234	67,717	6,286	90,237
August	15,152	66,342	6,511	88,005
September	15,234	66,324	6,779	88,337
October	15,616	66,876	6,060	88,552
November	17,847	68,718	6,900	93,465
December	17,341	67,091	6,255	90,687

Table 16.—Stocks of refined products by refineries with plants and pipelines in 1968, by months

(Thousand 42-gallon barrels)

Month	Gasoline [1]	Kerosine	Fuel oil		Jet fuel	Natural gas liquids	Miscellaneous products
			Distillate	Residual			
January	41,810	2,933	13,962	6,862	5,299	1,137	34,202
February	41,739	2,300	12,901	6,639	4,779	1,360	35,216
March	40,591	1,949	10,884	6,221	4,049	1,767	35,088
April	35,577	2,637	11,062	6,020	4,178	1,435	36,570
May	32,494	2,905	14,067	6,489	4,826	1,132	39,158
June	33,410	3,393	17,343	6,709	4,375	971	38,614
July	31,097	3,135	20,640	6,265	4,687	1,352	37,265
August	31,886	3,416	23,266	6,438	4,640	1,267	35,797
September	30,955	3,240	29,150	6,471	4,701	1,112	33,352
October	31,560	3,471	29,508	6,216	4,095	955	33,822
November	33,403	2,985	28,287	6,246	4,749	988	32,936
December	37,169	2,841	25,009	5,712	4,768	976	33,239

[1] Includes naphtha.

In north-central Texas (RRC Districts 7B and 9), drilling activity declined. Shackelford County recorded 29 oil discoveries, most of which were in Mississippian sediments. Young County had 10 oil discoveries. Wichita County did not have a successful exploratory test, but 214 oil producers resulted from 264 developmental wells. Montague County reported four oil discoveries, Jack County had two oil discoveries, and the following counties recorded one discovery each: Clay, Cooke, Foard, and Wilbarger. In RRC District 7B, Palo Pinto, Stephens, and Taylor Counties each had two oil discoveries. Callahan, Nolan, and Throckmorton Counties each had an oil discovery.

In the Texas Upper Gulf Coast, exploratory drilling resulted in 21 oil discoveries. Some important field discoveries included the West Hampton field, Hardin County; Bacon field, Jasper County; North McFaddin Ranch field, Jefferson County; and Norian field, Newton County.

Several thermal-recovery projects were operated in 1968. The Sun Oil Co., DX Division had excellent response to its fireflood in the Trix-Liz oilfield, Titus County. Low gravity oil (22°–24°), low reservoir pressures, and bentonitic type clays made steamflood and waterflood recovery methods uneconomic. Primary methods had recovered less than 1.2 million of the estimated 16 million barrels of oil in the reservoir. The company estimated an additional 3.2 million barrels will ultimately be recovered. Kimball Production Co. started a 135-acre steamflood in the Camp Hill field in Anderson County. About 2,000 barrels per day of steam was injected at 250 psi through seven injection wells. Other significant firefloods included the Union Texas Petroleum Co. operation in the Massie West field, Val Verde County. The company expects to recover an additional 525,000 barrels of oil from 11 feet of Paluxy oil sand in its pilot project. Sun Oil Co. began its second fireflood in the Glen Hummel field, Wilson County. The company estimated that recovery from the operation would be 3.9 million barrels of oil.

Sinclair Oil and Gas Co. started a unique multizone waterflood through a single tubing string in the Quicksand Creek field, Newton County. Sinclair expects to recover an additional 1.5 million barrels of oil from the combined pay zones.

Crude oil stocks in Texas at yearend totaled 90,687,000 barrels, an increase of 9 percent. Refinery stocks were 17,341,000 barrels, 22 percent of the U.S. total. Stocks at tank farms and in pipelines were 67,091,000 barrels, and on-lease stocks were 6,255,000 barrels. Refinery stocks were 16 percent greater than in 1967, pipeline and tank-farm stocks were 11 percent greater, and on-lease stocks declined 20 percent.

Crude oil refinery receipts rose 2 percent to 1,141,065,000 barrels and were 35 percent of U.S. total. Intrastate transportation facilities accounted for 64 percent of crude oil refinery receipts as follows: Pipeline, 697.9 million barrels; trucks, 9.8 million barrels; and water transportation, 27.4 million barrels. Interstate transportation modes to refineries were pipelines, 130.9 million barrels (a 10-percent increase); and water transportation, 133.6 million barrels (an 11-percent increase).

Texas refineries produced 511,362,000 barrels of gasoline—26 percent of the U.S. total and 4 percent greater than in 1967. Output of jet fuel, kerosine, distillate, diesel fuel, etc. amounted to 437,974,000 barrels—28 percent of the U.S. total and 6 percent greater than that in 1967. Liquefied refinery gas output amounted to 43,022,000 barrels (36 percent of the U.S. total), a 10-percent increase. Petrochemical feedstock production was 56,538,000 barrels—a 9-percent increase over 1967 production and 59 percent of the U.S. total.

Capacity of the 47 active oil refineries was 3,244,300 barrels per stream day, an increase of 3 percent over that in 1967, according to The Oil and Gas Journal. Nearly 27 percent of the U.S. capacity was in Texas. Oil refineries (idle or shut down during 1968) and their barrels-per-calendar-day capacities were as follows: Adobe Refining Co.'s Brownsville refinery, 3,500; Cosden Oil and Chemical Co.'s Hawley refinery, 6,500; Danaho Refining Co.'s Pettus refinery, 10,000; and Hess Oil and Chemical Corp.'s Port Isabel refinery, 14,300.

American Oil Co. completed the first phase of its multimillion-dollar expansion project at its Texas City refinery. Included in this first phase was a crude-oil distillation unit which increased capacity from 170,000 to 230,000 barrels per day, the world's largest ultraformer—a 40,000-barrel-per-day unit, and a 50,000-barrel-per-day aromatics-recovery unit. These additions have resulted in a 40-percent increase in steam requirements and a 35-percent increase in electric power requirements. Work commenced on the second phase of the expansion program that includes a 40,000-barrel-per-day ultracracking unit to convert heavy hydrocarbons into lighter fractions.

Cosden Oil & Chemical Co. increased crude capacity at its Big Spring refinery from 16,500 barrels per day to 47,000 barrels per day. Other additions included 10,000-barrel-per-day vacuum capacity, 3,000-barrel-per-day platforming capacity, 2,500-barrel-per-day unifining capacity, and 2,500-barrel-per-day asphalt capacity.

Crown Central Petroleum Co. increased its Houston refining capacity to 80,000 barrels per day with the addition of a 31,500-barrel-per-day fluid cat cracker, an 11,000-barrel-per-day cat reformer, a 5,000-barrel-per-day alkylation unit, and a 9,500-barrel-per-day delayed-coker unit.

Gulf Oil Corp. was building a 50,000-barrel-per-day powerformer unit at its Baytown refinery, and a 17,000-barrel-per-day delayed-coker unit at its Port Arthur facility. Tail gases and unstabilized gasoline from the new delayed-coker unit at the Port Arthur refinery will be further processed at an adjacent sulfur-removal and gasoline-fractionating unit to produce fuel gas, hydrogen sulfide, propane, butane, and light, intermediate, and heavy coker gasoline. Coke from the new drums will be released hydraulically.

New hydrofining units at Humble Oil & Refining Co.'s Baytown refinery will replace an older 20,000-barrel-per-day unit and provide needed capacity for increased jet fuel production. The company was installing two of the world's largest reformers at its Baytown, Tex., and Baton Rouge, La., refineries. The Baytown unit will replace an old 35,000-barrel-per-day unit. These reformers will produce premium gasoline and provide richer feedstocks for petrochemical units. Hydrogen produced at these units will be used in hydrotreating and in hydrocracking processes.

Modernization and expansion started at the Beaumont refinery of Mobil Oil Corp. will increase crude-oil capacity from 225,000 to 280,000 barrels per day. A new 120,000-barrel-per-day crude-oil distillation unit came on stream, a 42,000-barrel-per-day platinum reforming unit was being installed, a 29,000-barrel-per-day hydrocracker unit and a 60-MMcfd hydrogen unit were being built.

Shell Oil Co. expanded crude capacity at its Deer Park refinery from 160,000 to 225,000 barrels per day. Additions included a 25,000-barrel-per-day hydrocracking unit, a 36,000-barrel-per-day cat reforming unit, and an increase of 75-MMcfd hydrogen production capacity. Suntide Refining Co. completed a 6,500-barrel-per-day isomax unit at its Corpus Christi facility. Union Oil Company of California was building a 6,000-barrel-per-stream-day hydrotreating unit at its Beaumont plant. Texaco Inc., was building a 6,000-barrel-per-day hydrotreating unit at its Beaumont facility.

Petrochemicals.—The petrochemical industry has been one of the dynamic contributors to the economy since World War II. Texas has been foremost in plant capacity and production, in the number of petrochemical products, and in capital expenditures.

Construction involving new plants or expansions and modifications to existing plants included the Amoco Chemical Corp., subsidiary of Standard Oil Company (Indiana), 180-million-pound-per-year isopropanol and 240-million-pound-per-year acetone plant being built on a 2,400-acre site near Alvin, Brazoria County. Propylene will be produced by a 150-million-pound-per-year plant that Avisun Corp., an Amoco subsidiary, was building on the same site.

Celanese Chemical Co. was increasing capacities for ethylene oxide, ethylene glycol, glycol ethers, and ether acetates, at its Bayport chemical complex, and was increasing methyl ethyl ketone capacity to 50-million-pound-per-year at its Pampa facility. The company also was adding a 200-million-pound-per-year acetaldehyde capacity and 300-million-pound-per-year acetic acid capacity at its Clear Lake complex.

The Dow Chemical Co. was constructing a 400-million-pound-per-year phenol unit and a 1-billion-pound-per-year styrene unit at its Oyster Creek Division complex near Freeport. The phenol unit will use the cumene process rather than the more prevalent chlorobenzene or toluene process. Dow Badische Co. was building a 200-million-pound-per-year oxoalcohol plant at its new Freeport, Tex., chemical complex.

The complex will also make 2-ethyl hexanol, normal butanol, and isobutanol.

Ethyl Corp. started construction to increase capacity at its aluminum alkyls plant at Houston. The major market for these alkyls is long-chain linear alcohols which are the intermediate feedstocks for synthetic detergents.

Three major projects were underway to increase capacity for ethylene production: Union Carbide Corp.'s 1-billion-pound-per-year unit at Texas City, Shell Chemical Co.'s 1-billion-pound-per-year unit at Deer Park, and Gulf Oil Corp.'s 900-million-pound-per-year unit at Port Arthur. Ethylene capacity in Texas was estimated at 9,275 million pounds per year, or nearly 56 percent of the national capacity according to a mid-1968 Oil and Gas Journal survey.

National Distillers & Chemical Corp. started operations to increase capacity of the vinyl-acetate-monomer unit at its Deer Park complex from 200 to 300 million pounds per year. Rohm & Haas Co. started building a 400-million-pound-per-year methyl methacrylate facility at its Deer Park complex. Completion is scheduled for early 1970. Sun Oil Co., DX Division, added a 50-million-pound-per-year pseudocumene unit to its Corpus Christi refinery.

Goodrich Gulf Chemicals, Inc., expanded isoprene capacity at its Port Neches, Tex., plant to 120 million pounds per year and polyisoprene capacity at its Orange, Tex., plant to 100 million pounds per year. The company's Port Neches plant supplies the feedstock for its Orange synthetic rubber plant. The isoprene from the Port Neches plant is piped through a 12-mile line to the company's rubber unit at Orange. These facilities increased national capacity of cis rubber to 120,000 long tons per year, a 60-percent increase from 1967 capacity. Goodyear Tire & Rubber Co. completed a 14,000-long-ton-per-year plant expansion of its styrene-butadiene-rubber facility at Houston and added two units to its Beaumont synthetic rubber plant—one unit produces a resin used in pressure-sensitive tapes and hot-melt coatings; the other unit produces an antioxidant that protects rubber products from deterioration caused by the oxygen in the air.

Capacity of high-density polyethylene was expanded from 80 million pounds per year to 180 million pounds per year at the Texas City plant of Monsanto Co., and from 154 million to 193 million pounds per year at the Adams Terminal in Houston by Phillips Petroleum Co. Phillips completed its project late in 1968.

Hill Chemicals, Inc., completed an $18 million, 1,000-ton-per-day ammonia plant near Borger and contracted for a second 1,000-ton-per-day plant. The company started constructing an 850-mile, 6- and 8-inch ammonia pipeline from its Borger complex to northwest Iowa. Texas Eastman Co., Division of Eastman Kodak Co., increased acetaldehyde and hydrocarbon-cracking capacity at its Longview chemical complex.

Low-density polyethelene capacity was expanded by 100 million pounds per year at the Orange chemical complex of Gulf Oil Corp., and 125 million pounds per year at the Seadrift complex of Union Carbide Corp. Coastal States Petrochemical Co. was adding facilities to provide 180 million pounds per year cumene from a combined benzene and propylene feedstock at its Corpus Christi refinery. Diamond Shamrock Chemical Co. expanded polypropylene capacity to 70 million pounds per year at its chemical complex near Houston. A 200-million-gallon-per-year methanol plant was being built at the Beaumont facilities of E. I. du Pont de Nemours & Co., Inc. The Organic Chemicals Division of FMC Corp., completed a 40-million-pound-per-year glycerine unit at its Bayport complex. Sanford Chemical Co. was building a 4-million-pound-per-year benzyl chloride unit that will use a combined toluene and chlorine feedstock at its Port Neches chemical plant.

Facilities to produce 1,000 barrels per day of orthoxylene were being added to the Corpus Christi refinery of Southwestern Oil and Refining Co.

NONMETALS

The value of nonmetallic mineral production in Texas was up slightly from that of the previous year, registering a gain of 2.4 percent. The five principal commodities, in order of value, were cement, sulfur, stone, salt, and sand and gravel.

Barite.—No mining of crude barite was reported. Crude barite, obtained outside of Texas, was processed at the Brownsville plant of Dresser Minerals, Division of Dresser Industries, Inc.; at the Houston plant of The Milwhite Co., Inc.; and at the

Baroid Division of National Lead Co. in Corpus Christi. Most of the output, which decreased 12 percent from that of 1967, was used as an additive in oil- and gas-well drilling muds.

Bromine.—Elemental bromine was extracted from sea water at the Freeport plant of Ethyl-Dow Chemical Co. Most of the output went into the production of ethylene dibromide, used chiefly in antiknock compounds in leaded gasoline. Quantity and total value of ethylene dibromide produced in Texas declined during the year.

Cement.—The State's cement industry registered gains in production, shipments, and total value. Thirteen companies operated 20 plants. Total annual plant capacity was 47.8 million barrels of portland cement. The plants were in Bexar, Dallas, Ector, Ellis, El Paso, Harris, McLennan, Nolan, Nueces, Orange, Potter, and Tarrant Counties.

Portland cement shipments and total value increased 8 percent. Masonry shipments increased 19 percent, and total value increased 18 percent. Average price of portland cement was $3.12 per barrel, and average price of masonry cement was $3.18 per barrel.

Cement raw materials included more than 6.4 million short tons of limestone quarried in Bexar, Dallas, Ector, Ellis, El Paso, McLennan, Nolan, Potter, Tarrant, and Wise Counties. Cement plants located along the gulf coast used over 1.9 million short tons of shell obtained from shallow bays in Calhoun, Chambers, Galveston, Matagorda, and Nueces Counties.

Sixteen of the cement plants used the wet process, and four used the dry process. Total electricity used consisted of 78 million kilowatt-hours generated by these plants and 661 million kilowatt-hours purchased from outside sources. A total of 43 billion cubic feet of gas and 24,000 barrels of fuel oil were used.

Table 17.—Portland cement production, shipments, and consumption

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments		Consumption
		Quantity	Value	
1964	29,792	30,080	$94,492	26,156
1965	30,771	30,820	97,598	26,871
1966	31,487	30,827	97,188	26,995
1967	32,277	31,944	99,329	26,955
1968	34,161	34,499	107,532	28,856

Almost 56 percent of the portland cement shipments were to ready-mix companies. Other cement markets included building-material dealers; concrete-product manufacturers; highway and other contractors; Federal, State, and local government agencies; and miscellaneous customers.

In April, the 60-year-old Dallas plant of Lone Star Cement Corp. closed. Shortage of raw materials at the site and age of the facilities contributed toward closing of the plant. Lone Star Cement Corp. modernized and expanded its Houston plant.

Clays.—The clay industry of Texas showed gains during the year. Total clay production increased 4 percent, and the total value increased almost 10 percent. Tonnage and total value of miscellaneous clay, fire clay, ball clay, and kaolin increased. Output and total value of fuller's earth remained about the same; production and total value of bentonite showed a decrease. The five leading clay-producing counties in order of output were Eastland, Harris, Bexar, Henderson, and Galveston.

Table 18.—Clays sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Bentonite		Fire clay		Miscellaneous clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1964	111	$1,294	666	$1,815	3,379	$3,586	[1] 4,156	[1] $6,695
1965	114	829	735	1,999	3,605	3,832	[2] 4,469	[2] 6,865
1966	107	876	859	2,057	3,523	3,934	[2] 4,516	[2] 7,187
1967	97	660	748	1,862	3,598	4,882	[2] 4,497	[2] 8,081
1968	92	611	766	1,988	3,756	5,388	[2] 4,687	[2] 8,860

[1] Incomplete total excludes kaolin and fuller's earth (1964).
[2] Includes ball, kaolin, and fuller's earth.

Miscellaneous clay output accounted for 80 percent of total clay production. Approximately 36 percent of the miscellaneous clay was used in cement manufacture, and large amounts were used to make building brick and lightweight aggregate. Some of the output also was used in the manufacture of art pottery, floor and wall tile, vitrified sewer pipe, and other heavy clay products.

Fire clay was used in the manufacture of firebrick and block, building brick, vitrified sewer pipe, fertilizer, art pottery, and stoneware. Ball clay was used to make floor and wall tile; kaolin was used in the manufacture of rubber, fertilizer, and cement. Fuller's earth was used as an absorbent and as a soil conditioner. Bentonite was used as refractories in foundries, insecticide filler, filtering and decolorizing agent, absorbent filler in animal feed, and rotary-drilling-mud additive.

Clay production was reported from a total of 93 pits in 47 counties by 61 companies. Forty-four of the companies produced miscellaneous clay from 63 of the pits in 38 of the counties; 13 companies produced fire clay from 20 pits in 12 counties. Bentonite production was reported from six pits in four counties by five companies; fuller's earth was produced from two pits in two counties by two companies. Ball clay was produced from one pit, and kaolin was produced from one pit.

During the year, Texas Brick Co. became a part of Teague Brick and Tile Co. Reliance Brick Co. of Mineral Wells, subsidiary of Reliance Clay Products Co., leased for 5 years the brick-making facilities in Mesquite formerly operated by Crown Brick Manufacturing Co. General Refractories Co. installed an additional unit at Troup (Smith County) to produce a new line of specialties including ramming mixes and castables.

Gem Stones.—Dealers, hobbyists, and amateurs collected gem stones and rock and mineral specimens that included agate, calcite, jasper, fluorite, fossiliferous limestone, opal, petrified wood, topaz, and others.

Graphite.—Crystalline flake graphite in Precambrian metamorphic rocks was obtained from an open-pit mine in western Burnet County by Southwestern Graphite Co., and processed at the company mill. The company opened a new quarry and added new crushing and milling equipment. Natural graphite is used in batteries, crucibles, foundry facings, pencils, refractories, and for other purposes. Production was down from that of 1967.

Gypsum.—Production and total value of gypsum were 6 percent higher than in 1967.

Table 19.—Crude gypsum mined

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	1,131	$4,049
1965	1,045	3,794
1966	899	3,258
1967	984	3,419
1968	1,039	3,616

Seven companies reported production of gypsum from open pits in Fisher, Gillespie, Hardeman, Hudspeth, and Nolan Counties. Much of the gypsum was calcined and used in the manufacture of products such as plaster, plasterboard, tile, and other building materials. Uncalcined gypsum was used chiefly as a retarder in portland cement.

Crude gypsum, mined outside of Texas, was calcined at two plants—one in Irving and the other in Galena Park.

In Hardeman County, facilities at the Acme plant of the Georgia-Pacific Corp., a producer of crude gypsum and manufacturer of gypsum board, were expanded by the addition of two new calcining kettles, two grinding mills, four new storage tanks, and a fully automated conveyor system for handling rock, and by the construction of a new 130,000-square-foot board plant.

During the year, Elcor Chemical Corp., of Midland, was developing an open-pit gypsum mine at the Rock House facility northeast of Van Horn, Culberson County. Elcor planned to use the gypsum as the raw material in a sulfur-extracting process.

Lime.—Total lime production was virtually unchanged; total value was up 2 percent. Eleven companies reported production of lime at 15 plants. The output of hydrated lime was down about 10 percent; output of quicklime, however, was up over 8 percent.

Table 20.—Lime sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quick-lime	Hydrated lime	Total	
			Quantity	Value
1964	764	586	1,350	$17,201
1965	717	621	1,338	19,663
1966	802	671	1,473	18,696
1967	854	711	1,564	20,713
1968	926	638	1,564	21,154

Almost 72 percent of the total lime production was used for chemical and other industrial purposes—an increase of over 7 percent for the year. Lime used for construction was down 11 percent; agricultural and refractory uses also declined.

Brazoria County led in lime output followed by Nueces and Comal Counties. Production was reported also from Calhoun, Harris, Hill, Jasper, Johnson, Travis, and Williamson Counties. In addition, McDonough Bros., Inc., began production of hydrated lime in Bexar County. The plant, which is equipped with a rotary kiln, is near the company's limestone quarries at Beckman, north of San Antonio.

Magnesium Compounds.—Magnesium chloride and other magnesium compounds were produced from raw sea water of the Gulf of Mexico at the Freeport plant of The Dow Chemical Co. in Brazoria County. Output was up from that of 1967. Also at Freeport, a significant quantity of magnesium hydroxide, supplied by The Dow Chemical Co., was processed to obtain magnesium oxide by A. P. Green Refractories Co., subsidiary of United States Gypsum Co., and by E. J. Lavino & Co., Division of International Minerals & Chemical Corp.

Mica.—No production of mica was reported from Texas deposits. Out-of-State mica was ground at the Fort Worth plant of Western Mica Company, Division of United States Gypsum Co., for use in paint.

Natural Sodium Sulfate.—Ozark-Mahoning Co. obtained natural sodium sulfate from brines in shallow alkali-lake beds in Gaines, Terry, and Ward Counties and processed it into salt cake at plants near Brownfield, Monahans, and Seagraves. Production of salt cake, which is used in preparing kraft paper, glass, detergents, and other products, was up from 1967 levels.

Perlite.—The open-pit perlite mine of Perlite Producers, Inc., on the Shely Ranch about 40 miles southwest of Marfa, Presidio County, was inactive during 1968. Crude perlite mined outside of Texas was expanded at seven plants in Dallas, Fort Worth, Houston, Irving, La Porte, Midland, and Sweetwater. Expanded perlite was used as filler, filter aid, loose-fill insulation, concrete lightweight aggregate, soil conditioner, additive in building plaster, and for other purposes such as an oil absorbent, insulating grout, and ingot insulation.

Pumicite (Volcanic Ash).—Pumicite was mined from open pits near Rio Grande City in Starr County by Pozzolana Corp. and prepared for use in concrete admixtures and as insecticide carriers. Output was higher than that of 1967.

Salt (Sodium Chloride).—Salt production and value exceeded records set in 1967; tonnage was up 2 percent and total value was up 17 percent. The salt was obtained from mines and from wells drilled into salt domes and into subsurface salt beds. Nine companies reported production from 11 operations in Brazoria, Chambers, Duval, Fort Bend, Harris, Hutchinson, Jefferson, Van Zandt, Ward, and Yoakum Counties. The three principal salt-producing counties, in order of output, were Brazoria, Duval, and Chambers.

Table 21.—Salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	6,410	$28,797
1965	6,964	30,771
1966	7,724	33,797
1967	8,344	36,435
1968	8,534	42,663

Salt was a vital ingredient of the State's chemical industry. Brine made up most of the total salt production and was used in large quantities to prepare caustic soda, chlorine, and soda ash. Some of the other uses of salt included pulp and paper manufacture, water softening, and meatpacking. Morton Salt Co. started an additional shaft into the Grand Saline salt dome in Van Zandt County. The new 700-foot shaft will be used to transport supplies and personnel.

Sand and Gravel.—Total output of sand and gravel increased about 1 percent, and total value increased 6 percent. Texas ranked eighth in the country in sand and gravel production.

Table 22.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1964	25,249	$30,896	3,906	$2,498	29,155	$33,394
1965	27,488	33,572	5,161	2,503	32,649	36,075
1966	23,089	28,947	3,133	2,366	26,222	31,313
1967	25,397	33,630	6,001	5,539	31,398	[1] 39,170
1968	[2] 27,919	38,183	3,924	[2] 3,363	31,843	41,546

[1] Data do not add to this total because of independent rounding.
[2] Final figure, supersedes figure given in commodity chapter.

Table 23.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	6,073	$6,059	5,788	$6,330
Paving	3,726	3,597	4,284	4,493
Fill	865	514	879	643
Other [1]	1,278	4,921	1,448	5,006
Total	11,942	15,091	12,399	16,472
Gravel:				
Building	7,726	11,462	7,807	11,369
Paving	5,084	6,212	6,788	9,114
Fill	302	186	338	261
Other [2]	343	679	587	967
Total	13,455	18,539	15,520	21,711
Total sand and gravel	25,397	33,630	[3] 27,919	38,183
Government-and-contractor operations:				
Sand:				
Building	61	33	19	24
Paving	1,107	697	280	249
Fill	--------	--------	10	5
Other	--------	--------	1	1
Total	1,168	730	310	279
Gravel:				
Building	10	14	25	32
Paving	4,817	4,793	3,547	3,026
Fill	6	3	42	26
Total	4,833	4,810	3,614	3,084
Total sand and gravel	6,001	[4] 5,539	3,924	[3] 3,363
Grand total	31,398	[4] 39,170	31,843	41,546

[1] Includes railroad ballast (1968), other construction sand, and industrial sand (unground and ground).
[2] Includes railroad ballast (1967), miscellaneous, and other construction gravel.
[3] Final figure, supersedes figure given in commodity chapter.
[4] Data do not add to total because of independent rounding.

Production was reported from 110 of the State's 254 counties. Commercial production was reported from 182 operations and accounted for almost 88 percent of the total output. Noncommercial (Government-and-contractor) operations accounted for the remainder, most of which was produced for the Texas Highway Department. Almost 90 percent of the State's total sand and gravel output was used for building and paving.

Ninety-six percent of the commercial sand and gravel was washed or otherwise processed before use. Average price of the processed commercial material was $1.40 per short ton; pit-run material averaged $0.64 per short ton.

Commercial sand and gravel production was transported by trucks, 64 percent; railroads, 31 percent; and waterways, 5 percent.

Stone.—Total value of stone production declined 6 percent. Shell constituted 16 percent of the total stone production, and limestone was 75 percent. Other production included basalt (traprock), dolomite, granite, graphitic schist, marble, marl, metarhyolite, quartzite, and sandstone. Although output of basalt, granite, marble, and metarhyolite was up during the year, the large decline in shell production resulted in a 2-percent decline in output from 1967. Output came from 79 counties from a total of 213 operations. Leaders in stone production, in order of output, were Wise, Bexar, Matagorda, Williamson, and Ellis Counties.

Crushed stone was over 99 percent of total stone production; output declined about 2 percent, and total value declined 6 percent. Principal uses of crushed stone were as concrete aggregate, roadstone, raw material for preparing cement and lime, and riprap.

Production of dimension stone, which included granite, marble, limestone, and quartzite, declined 12 percent, although total value was up 7 percent.

Parker Brothers & Co., Inc., a producer of sand, gravel, and shell, opened a new limestone quarry in the Cretaceous Edwards Formation on a 550-acre site south of New Braunfels in Comal County. Servtex Materials Co., a producer of crushed limestone near Ogden, about 10 miles southwest of New Braunfels, was purchased by Highland Resources, Inc., Houston Materials Division, for an amount reported to be over $3 million. Bilbrough Marble Co., a producer of marble terrazzo chips, roofing aggregate, and other special aggregates, transferred the facilities of its Llano plant to the company's Demarco plant at Burnet. The quarry at Llano, however, continued to operate. Lone Star Cement Corp., purchased the assets of W. D. Haden Company, a Texas shell producer.

Sulfur.—Production of Frasch sulfur increased over 8 percent. Reduced demand, however, resulted in a 25-percent decline in shipments and a buildup of stockpiles. By yearend, producer stocks had increased 115 percent. Total value of Frasch shipments decreased almost 6 percent. Average value was $41.03 per ton in 1968, compared with $32.46 per ton in 1967.

Production was reported from 11 Frasch sulfur operations. Nine plants were located on the Texas gulf coast where sulfur was obtained from salt-dome caprock in Brazoria, Fort Bend, Jefferson, Liberty, Matagorda, and Wharton Counties. The plant in Brazoria County (at Bryan Mound salt dome) was closed at yearend when Hooker Chemical Corp. discontinued operations.

Two Frasch plants were operated in

Table 24.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Limestone [1]		Sandstone [2]		Shell		Total [3]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1964	28,263	$31,950	1,304	$1,753	9,990	$15,077	40,240	$52,070
1965	27,882	31,095	881	1,423	9,689	15,356	39,520	53,659
1966	32,373	39,591	1,257	1,729	9,365	12,839	43,578	56,659
1967	36,153	40,372	2,012	2,270	10,776	15,417	49,424	61,577
1968	36,121	38,957	1,222	1,773	7,851	10,785	48,480	58,006

[1] Includes dolomite through 1967.
[2] Includes quartzite through 1967.
[3] Includes other stone to avoid disclosing individual company confidential data.

Pecos County to obtain sulfur from subsurface Permian deposits. The plant of Duval Corp. was being expanded to 1,000 long tons per day, and Sinclair Oil Corp. expanded its plant into a 300-long-ton-per-day facility.

Table 25.—Sulfur produced and shipped from Frasch mines

(Thousand long tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1964	2,489	3,302	$65,780
1965	2,534	3,674	83,282
1966	2,916	3,703	96,820
1967	2,956	3,448	111,931
1968	3,203	2,571	105,482

Duval Corp., after conducting a successful pilot operation about 18 miles southwest of Orla, began construction of a 1.5-million-long-ton-per-year Frasch plant. Elcor Chemical Corp. completed its 1,000-long-ton-per-day plant that extracts sulfur from gypsum. The plant is about 35 miles northeast of Van Horn. Allied Chemical Corp. conducted an experimental pilot Frasch operation about 5 miles west of Christoval.

Other sources of sulfur in Texas were sour gas and oil. Sulfur was obtained from 39 recovery plants located in 21 counties of the State. Shipments of sulfur from these plants totaled 645,925 long tons with a total value of $25,494,833. Average price was $39.47 per long ton.

Most of the sulfur output was consumed by the acid industry. Chief uses of sulfuric acid were in the preparation of products such as fertilizers, alcohols, rayon, explosives, pulp and paper, and in the refining of petroleum and the pickling of iron and steel. Nonacid uses of sulfur included the production of wood pulp, paper, and cellulosic fibers.

Talc and Soapstone.—Five producers mined talc and soapstone. Output was 39 percent greater than that of 1967 and was used in ceramics, insecticides, paint, roofing material, textile manufacture, and for other purposes. A talc-grinding mill was operated in Allamoore (Hudspeth County) and another in Llano (Llano County).

Vermiculite.—Perlite Producers, Inc., mined and exfoliated vermiculite in Llano County. Production was up from that of 1967. Crude vermiculite mined outside of Texas was processed at plants in Dallas, Houston, and San Antonio for uses such as lightweight aggregate, soil conditioner, additive in plaster, and for other purposes. Total output of exfoliated vermiculite was up 20 percent during the year.

METALS

The metals sector contributed less than 1 percent of the State's total mineral value in 1968. Metal mining in Texas in 1968 was limited to iron ore, mercury, and uranium. Magnesium metal was recovered by chemical methods from gulf seawater. There are three principal mineral areas in the State: The East Texas iron ore belt, the Central Mineral region with the ancient geologic hills of the Llano uplift, and the Trans-Pecos region in West Texas.

A major strike by workers of the copper industry which began in mid-1967 was settled in March 1968. Labor disputes also occurred in construction and steel industries.

The Texas City tin smelter of Wah Chang Corp. was sold to Fred H. Lenway and Co., Inc., on September 1, 1968, and was operated as the Lenway Chemical and Metallurgical Co. The Lenway organization, which owns five other mineral processing plants in the State, planned to produce other products besides tin at its Texas City facility.

A 30,000-ton-per-year magnesium reduction plant was being built at Snyder, Scurry County. Feedstock for the plant will be underground brines (with high magnesium chloride content) obtained in the vicinity of Gail in adjoining Borden County.

Diamond Shamrock Corp. began production of mercury at the Study Butte mine near Terlingua, Brewster County.

Uranium exploration activity continued in the south-central region of Texas, principally in Karnes, Live Oak, and McMullen Counties.

Aluminum.—Texas again ranked second in production during 1968 and had a total annual capacity of 560,000 tons of primary metal including a 50,000-ton unit under construction at Rockdale. Alumina was produced from bauxite shipped into Texas from other States and foreign countries at the 900,000-ton Point Comfort plant of Aluminum Company of America (Alcoa) and at the 200,000-ton San Patricio plant of Reynolds Metals Co.

Alcoa added a seventh 50,000-ton-per-year potline to its Rockdale facility during 1968 and began construction of an eighth 50,000-ton-per-year potline at the same facility. Alcoa also operated a 175,000-ton-per-year aluminum reduction plant at Point Comfort.

Reynolds Metals Co. completed expansion of electric-generating works and alumina facilities at its Sherwin operation in San Patricio County. The new alumina facility now has a daily capacity of 3,000 tons. Reynolds Metals Co. plans another daily increase of 250 tons to a total of 3,250 tons by 1970. The company added 11 generators to its reduction works. This added 25,400 kilowatts of direct current and 3,350 kilowatts of alternating current capacity to the plant. The reduction plant had a total of 105 generators housed in three separate buildings.

Antimony.—Primary antimony metal was produced at the Laredo smelter of National Lead Co., principally from Mexican ores. The smelter operated at reduced capacity during 1968. The secondary supply of antimony principally from antimonial lead continued to decline.

Cadmium.—Cadmium was recovered as a byproduct of zinc retort smelting from zinc dust and residues. These residues were shipped to other zinc smelters having cadmium recovery facilities such as the electrolytic plant of American Smelting and Refining Company at Corpus Christi. Cadmium production in Texas declined 3.7 percent.

Copper.—Although deposits of copper minerals are known to occur in the Trans-Pecos region, in the Permian "red beds" of north central Texas, and in the Central Mineral region (Llano uplift), no production has been reported in recent years.

Scrap copper and ores and concentrates from other States and from foreign countries were processed at the El Paso smelter of American Smelting and Refining Company. Phelps Dodge Refining Co. expanded blister and anode copper capacity at its El Paso electrolytic refinery from 320,000 tons to nearly 400,000 tons per year during 1968. Neither the smelter nor the refinery operated at yearly capacity due to a 9-month strike of mine and smelter workers. The strike which began in July 1967 was settled in March 1968.

Ferroalloy Metals (Chromium, Manganese, Molybdenum, Tungsten).—Scattered

Table 26.—Smelters, refineries, and reduction plants in 1968

Product, company, and plant	Location (county)	Material treated
Aluminum:		
Aluminum Company of America:		
Point Comfort (alumina)	Calhoun	Bauxite.
Point Comfort (reduction)	do	Alumina.
Rockdale (reduction)	Milam	Do.
Reynolds Metals Co.:		
Sherwin Works (alumina)	San Patricio	Bauxite.
San Patricio (reduction)	do	Alumina.
Antimony: National Lead Co.: Laredo smelter	Webb	Ore.
Cadmium: American Smelting and Refining Company: Electrolytic.	Neuces	Flue dust.
Copper:		
American Smelting and Refining Company: El Paso smelter.	El Paso	Ore and concentrates.
Phelps Dodge Refining Corp.: Nichols refinery	do	Blister and anode.
Iron:		
Lone Star Steel Co.: Daingerfield plant	Morris	Ore and scrap.
Armco Steel Corp.: Houston plant	Harris	Do.
Lead: American Smelting and Refining Company: El Paso smelter.	El Paso	Ore and concentrates.
Magnesium: The Dow Chemical Co.: Freeport plants, Electrolytic.	Brazoria	Sea water.
Manganese: Tenn-Tex Alloy & Chemical Corp	Harris	Ore.
Tin-Tungsten: Fred H. Lenway & Co., Inc.: Texas City smelter.	Galveston	Do.
Zinc:		
American Smelting and Refining Company:		
Amarillo retort smelter	Potter	Ore and concentrates.
Corpus Christi electrolytic	Nueces	Do.
El Paso fuming plant	El Paso	Dusts and residues.
American Zinc Co.: Dumas retort smelter	Moore	Concentrates and fumes.

Table 27.—Secondary metal recovery plants

County and company	Material	Products
Dallas:		
ABASCO, Inc	Aluminum scrap	Aluminum ingots, dioxidizing bars and shot.
American Smelting and Refining Company.	Lead and zinc scrap	Lead and zinc ingots, pigs, alloys.
Dixie Lead Co	Lead scrap	Lead pigs, alloys, chemicals.
National Lead Co., Southwestern Branch.	Battery plates	Lead products.
Southern Lead Co	do	Lead pigs, alloys.
El Paso: Border Steel Mills, Inc	Steel scrap	Steel shapes, reinforcing bars.
Gregg: R. G. LeTourneau, Inc	do	Heavy mobile equipment.
Guadalupe: Structural Metals, Inc	do	Structural steel reinforcing bars.
Harris:		
A & B Metal & Smelting Co	Aluminum, lead scrap	Lead pigs, ingots, aluminum ingots, alloys.
Federated Metals	Various metals	Lead products, alloys of copper, lead, zinc, magnesium, tin.
Gulf Reduction Corp	Aluminum, zinc scrap	Aluminum and zinc ingots, alloys.
Houston Lead Co	Lead scrap	Lead pigs, ingots, alloys.
Houston Fishing Tackle Co	Soft lead scrap	Lead products.
Lead Products, Inc	Lead scrap	Lead pigs, ingots, alloys.
Magnus Metal	Various metal scrap	Lead, brass, bronze bearing metal.
Southwest Saw Corp	Steel scrap	Steel alloys.
Sterling Type, Rule, & Metals Co	Type metal	Type metal.
Vulcan Detinning Co	Tinned scrap	Refined tin, baled detinned steel.
Tarrant:		
National Metal & Smelting Co	Battery lead and aluminum scrap.	Lead pigs, ingots, battery metal, aluminum ingots.
Texas Steel Co	Steel scrap	Carbon and alloy steel bars and shapes, reinforcing bars.

deposits of chromium in the form of chromite are known to occur in Precambrian rocks in Blanco and Gillespie Counties of the Central Mineral region. No record of commercial production of this material is known for Texas. Manganese deposits, mostly as oxides with some silicates, occur along the Pecos River in Val Verde County, in Jeff Davis County of the Trans-Pecos region, and in Mason and Llano Counties of the Central Mineral region. Small intermittent production has been reported from the Llano, Mason, and Jeff Davis County areas, but to date none of these deposits have proved economic. Molybdenum deposits are known to occur in Llano County and in Tertiary rocks in the Quitman Mountains of Hudspeth County. Efforts to produce from these deposits have proved unsuccessful in the past. Tungsten occurs as scheelite in Llano and Hudspeth Counties, and other tungsten minerals occur in Culberson County. No recent production is known.

Iron Ore.—Large deposits of iron ore in the form of siderite and limonite occur in Cass, Cherokee, Morris, and other counties in northeast Texas. Small deposits of iron in the form of magnetite occur in the Precambrian rocks of the Central Mineral region.

Iron ore shipments in 1968 were 24 percent under those reported in 1967, and value declined 16 percent. The declines were due primarily to an extended labor strike at Lone Star Steel Co.

Lone Star Steel Co. began construction of a new headquarters building in Dallas. Armco Steel Corp. began construction of a $2.2 million waste gas cleaning unit at its Houston works. A pipe-rolling mill was being built in the Houston area by Brown and Root, Inc. The mill will have an annual capacity of 78,000 tons and will be able to cold-roll plate steel up to 3 inches in thickness. Union Carbide Corp. began construction of a plant to apply wear-resistant coatings to machine parts and tools to reduce abrasion, corrosion, frictional or rolling wear, and excessive heat. These coatings include oxides, carbides, and alloys of refractory metals such as titanium and molybdenum and pure metals of aluminum and nickel.

Lead.—Lead, usually associated with zinc or silver, is known to occur in Hudspeth, Presidio, and Brewster Counties, and in the Central Mineral region. No production is known since the closing of the Presidio mine.

Magnesium.—Magnesium metal was recovered from gulf waters by a chemical and electrolytic process at two plants of The Dow Chemical Co. at Freeport, Brazoria County. These plants have a combined capacity of 100,000 tons of metal per year. Magnesium chloride and magnesium sulfate occur in underground brines and in playas of the High Plains. A magnesium plant was being built near Snyder in Scurry County by American Magnesium Co. The plant will process subsurface brines from Gail, Borden County, by an electrolytic process. The company expects to recover nearly 3 pounds of chlorine as a byproduct for every pound of magnesium metal produced, and start up is expected in 1969.

Mercury.—Mercury production and total value increased. Diamond Shamrock Corp. reopened an extension to the Study Butte mine, Brewster County. The mine was deepened and ore producing facilities installed in the underground workings. The company moved a 100-ton-per-day ore processing plant from California.

Tin.—A smelter at Texas City, built by the Federal Government in 1942, was operated by Fred H. Lenway and Co., Inc. In 1968 a small quantity of tin and tin alloys were recovered at the smelter.

Uranium.—Exploration for uranium continued at a rapid pace. Eleven oil, mining, and chemical companies were active in a six-county area in south-central Texas. These companies drilled a total of 3.3 million feet of hole in 1968 according to the Atomic Energy Commission. This drilling resulted in finding considerable uranium reserves and enhanced prospects for a second uranium processing mill for the State. Four companies—Amarillo Minerals, Inc., Atlantic Richfield Co., Humble Oil & Refining Co., and Tenneco, Inc.—reported discoveries of uranium in Live Oak and Karnes Counties. Uranium ores from 14 operations in Karnes County were processed by Susquehanna-Western, Inc.

Zinc.—Zinc concentrates from foreign countries and from other States were processed at the 108,000-ton electrolytic plant at Corpus Christi and at the 58,000-ton Amarillo retort plant of American Smelting and Refining Company. American Zinc Co. also produced zinc metal at its 58,000-ton Dumas retort smelter.

Coastal Galvanizing Co. added a 42-foot kettle with a capacity of 800,000 pounds of molten zinc to its Houston plant.

Table 28.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt (native):			
Uvalde Rock Asphalt Co	San Antonio, Tex	Mine	Uvalde.
White's Uvalde Mines, Inc		do	Do.
Barite:			
Dresser Minerals	Houston, Tex	Grinding plant	Cameron.
The Milwhite Co., Inc		do	Harris.
National Lead Co		do	Nueces.
Bromine: Ethyl-Dow Chemical Co.	Midland, Mich	Plant	Brazoria.
Cement:			
Alpha Portland Cement Co	Easton, Pa	Quarry and plant	Orange.
Capitol Aggregates, Inc., Capitol Cement Div.	San Antonio, Tex	Plant	Bexar.
Centex Cement Corporation	Corpus Christi, Tex	Quarry and plant	Nueces.
General Portland Cement Co., Trinity Div.	Dallas, Tex	do	Dallas, Harris, Tarrant.
Gifford-Hill Portland Cement Co.	Midlothian, Tex	do	Ellis.
Gulf Coast Portland Cement Co., Div. of McDonough.	Houston, Tex	do	Harris.
Ideal Cement Co., Texas Portland Cement Div.	Denver, Colo	do	Do.
Kaiser Cement & Gypsum Corp.	Permanente, Calif	Plant	Bexar.
Lone Star Cement Corp	Dallas, Tex	Quarry and plant	Harris and Nolan.
San Antonio Portland Cement Co.	San Antonio, Tex	do	Bexar.
Southwestern Portland Cement Co., Southwest Div.	El Paso, Tex	do	Ector, El Paso, Potter.
Texas Industries, Inc	Midlothian, Tex	do	Ellis.
Universal Atlas Cement Div., U.S. Steel Corp.	Pittsburgh, Pa	do	McLennan.

Table 28.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays:			
Acme Brick Co	Fort Worth, Tex	Mine and plant	Ellis, Guadalupe, Harris, Henderson, Nacogdoches, Parker, Wise.
Dresser Minerals	Houston, Tex	do	Angelina and Limestone.
Elgin Butler Brick Co	Austin, Tex	do	Bastrop.
Featherlite Co. of San Antonio.	Converse, Tex	do	Bexar.
Featherlite Corp	Ranger, Tex	do	Eastland.
General Portland Cement	Dallas, Tex	do	Dallas, Harris, Limestone.
Henderson Clay Products Co	Henderson, Tex	do	Rusk.
Ideal Cement Co	Denver, Colo	do	Galveston.
Lone Star Cement Corp	Dallas, Tex	do	Fisher, Harris, Dallas.
Texas Clay Products, Inc	Malakoff, Tex	do	Henderson.
Texas Industries, Inc	Dallas, Tex	do	Dallas, Fort Bend, Eastland, Ellis.
Coal (lignite):			
Atlas Chemical Indust., Inc	Marshall, Tex	Strip mine	Harrison.
Industrial Generating Co	Rockdale, Tex	do	Milam.
Graphite: Southwestern Graphite Co.	Burnet, Tex	Mine	Burnet.
Gypsum:			
The Celotex Corporation	Tampa, Fla	Mine and calcining plant.	Fisher.
Fredericksburg Gypsum Co	Houston, Tex	Mine	Gillespie.
Georgia-Pacific Corp	Portland, Oreg	Mine and calcining plant.	Hardeman.
The Flintkote Co	East Rutherford, N.J	do	Nolan.
National Gypsum Co	Buffalo, N.Y	do	Fisher.
Southwestern Portland Cement Co.	El Paso, Tex	Mine	Hudspeth.
United States Gypsum Co	Sweetwater, Tex	Mine and calcining plant.	Nolan.
Do	Chicago, Ill	Calcining plant	Harris.
Texas Gypsum Co., Inc	Irving, Tex	do	Dallas.
Iron ore:			
Lone Star Steel Co	Dallas, Tex	Open pit	Morris.
Jennings and Halbert	Dialville, Tex	do	Cherokee.
Mathis & Mathis Mining & Exploration Co.	Linden, Tex	do	Cass.
Lime:			
Aluminum Co. of America	Pittsburgh, Pa	Plant	Calhoun.
Armco Steel Corp	Houston, Tex	do	Harris.
Austin White Lime Co	McNeil, Tex	do	Travis.
Champion Papers, Inc	Pasadena, Tex	do	Harris.
The Dow Chemical Co	Midland, Mich	do	Brazoria.
Eastex, Inc	Silbee, Tex	do	Jasper.
PPG Industries, Inc	Corpus Christi, Tex	do	Nueces.
Round Rock Lime Co	Round Rock, Tex	do	Hill and Williamson.
Texas Lime Co	Cleburne, Tex	do	Johnson.
U.S. Gypsum Co	Chicago, Ill	do	Comal and Harris.
White Stone & Lime Co	Leander, Tex	do	Williamson.
Magnesium compounds:			
The Dow Chemical Co	Midland, Mich	do	Brazoria.
A. P. Green Refractories Co	Freeport, Tex	do	Do.
E. J. Lavino & Co	Philadelphia, Pa	do	Do.
Mercury:			
Butte Mining Corp	Terlingua, Tex	Mine	Brewster and Presidio.
Diamond Shamrock Corp		do	Brewster.
Mica: Western Mica Company, Div. U.S. Gypsum Co.	Chicago, Ill	Plant	Tarrant.
Perlite:			
Filter Media, Inc	Houston, Tex	do	Harris.
Perlite of Houston, Inc		do	Do.
Perlite Industries, Inc	Midland, Tex	do	Midland.
Perlite Products Co	Dallas, Tex	do	Dallas.
Sil-Flo Corp	Fort Worth, Tex	do	Tarrant.
Texas Lightweight Products Co.	Irving, Tex	do	Dallas.
United States Gypsum Co	Chicago, Ill	do	Nolan.
Salt:			
Diamond Shamrock Corp	Cleveland, Ohio	Brine wells	Chambers.
The Dow Chemical Co	Midland, Mich	do	Brazoria.
Montex Chemical Co	Monahans, Tex	do	Ward.

Table 28.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Salt—Continued			
Morton Salt Co	Chicago, Ill	Underground mine and brine wells.	Van Zandt.
Phillips Petroleum Co	Bartlesville, Okla	Brine wells	Hutchinson.
PPG Industries, Inc	Corpus Christi, Tex	do	Duval.
Texas Brine Corp	Houston, Tex	do	Jefferson and Harris.
United Salt Corp		Underground mine and brine wells.	Fort Bend and Harris.
Vulcan Materials Co	Denver City, Tex	Brine wells	Yoakum.
Sand and gravel:			
Barrett Industries	San Antonio, Tex	Stationary	Bexar.
Capitol Aggregates, Inc		do	Bexar, Guadalupe, Travis.
Dresser Minerals	Kosse, Tex	do	Limestone.
The Fordyce Co	San Antonio, Tex	do	Hidalgo, San Patricio, Victoria.
Fort Worth Sand & Gravel Co.	Arlington, Tex	do	Dallas and Tarrant.
Gifford-Hill & Co., Inc	Dallas, Tex	do	Brazos, Dallas, McLennan, Tarrant, Wharton, Wichita.
Horton & Horton	Houston, Tex	Dredge	Colorado and San Jacinto.
Do		Stationary	Victoria.
R. E. Janes Gravel Co	Austin, Tex	do	Borden, Howard, Jones, Stonewall, Taylor.
Janes-Prentice, Inc		do	Crosby.
Olmos Rock Products Corp	San Antonio, Tex	do	Bexar.
Panhandle Gravel West, Inc	Amarillo, Tex	do	Armstrong.
Parker Bros. & Co	Houston, Tex	Dredge	Colorado and Harris.
Pennsylvania Glass Sand Corp.	Berkeley Springs, W. Va	Stationary	McCulloch.
Permian Sand & Gravel Co., Inc.	Odessa, Tex	do	Reeves.
Texas Construction Materials Co.	Houston, Tex	Stationary, portable and dredges.	Colorado and Liberty.
Texas Mining Corp	Dallas, Tex	Stationary	McCulloch.
Thorstenberg Materials Co	Houston, Tex	Stationary and portable.	Colorado.
Do		Stationary	Fayette.
Do		Dredge	San Jacinto.
Wesco-Wamix, Inc	Dallas, Tex	Stationary	Dallas, Denton, Navarro, Tarrant.
Shell:			
Bauer Dredging Company	Port Lavaca, Tex	Dredges	Calhoun.
Corpus Christi Shell Co., Inc.	Corpus Christi, Tex	do	Nueces.
General Dredging Corp		do	Do.
W. D. Haden Company	Houston, Tex	do	Chambers.
Heldenfels Brothers	Corpus Christi, Tex	do	Aransas and Nueces.
Horton & Horton	Houston, Tex	do	Galveston.
Matagorda Shell Co., Inc	Matagorda, Tex	do	Matagorda.
Parker Brothers & Co., Inc	Houston, Tex	do	Galveston.
Sodium sulfate (natural): Ozark-Mahoning Co.	Tulsa, Okla	Plant	Gaines, Terry, Ward.
Stone:			
Austin White Lime Co	Austin, Tex	Quarry	Travis.
Border Road Constr. Co	Monahans, Tex	do	Various.
East Texas Stone Co	Corsicana, Tex	do	Freestone.
Gifford-Hill & Co., Inc	Dallas, Tex	do	Wise.
McDonough Bros., Inc	San Antonio, Tex	do	Bexar.
Servtex Materials Co	New Braunfels, Tex	do	Comal.
Southwestern Portland Cement Co.	El Paso, Tex	do	Ector, El Paso, Potter.
Texas Construction Materials Co.	Houston, Tex	do	Burnet.
Texas Crushed Stone Co	Austin, Tex	do	Williamson.
Texas Granite Corp	Marble Falls, Tex	do	Burnet.
Texas Industries, Inc	Dallas, Tex	do	Ellis and Wise.
Trinity Concrete Products Co.		do	Johnson and Wise.
Wesco-Wamix, Inc		do	Wise.
White's Mines, Inc	San Antonio, Tex	do	Brown, Taylor, Uvalde.

Table 28.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sulfur (native):			
Duval Corp	Houston, Tex	Frasch process	Pecos and Fort Bend.
Hooker Chemical Corp	Freeport, Tex	do	Brazoria.
Jefferson Lake Sulphur Co	New Orleans, La	do	Fort Bend.
Phelan Sulphur Co	Houston, Tex	do	Do.
Sinclar Oil Corp	Tulsa, Okla	do	Pecos.
Texas Gulf Sulphur Co	New York, N.Y	do	Jefferson, Liberty, Matagorda, Wharton.
Sulfur (byproduct):			
Getty Oil Company	Scroggins, Tex	Secondary recovery	Franklin.
Gulf Oil Corp	Port Arthur, Tex	do	Jefferson.
Pan American Petroleum Corp.	Tulsa, Okla	do	Andrews, Ector, Hockley, Van Zandt, Wood.
Phillips Petroleum Co	Bartlesville, Okla	do	Brazoria, Crane, Ector, Hutchinson.
Shell Oil Co	Houston, Tex	do	Cass and Karnes.
Warren Petroleum Corp	Tulsa, Okla	do	Crane, Hopkins, Karnes.
Talc:			
Dallas Ceramic Co	Allamoore, Tex	Mine	Hudspeth.
Pioneer Talc Co	Chatsworth, Ga	Plant	Do.
Southern Clay Products, Inc	Gonzales, Tex	Mine	Do.
The United Sierra Div., Cyprus Mines Corp.	Trenton, N.J	do	Hudspeth and Gillespie.
Do		Plant	Llano.
Westex Talc Co	Houston, Tex	Mine and plant	Hudspeth.
Uranium: Susquehanna-Western, Inc.	Falls City, Tex	Mine	Karnes.
Vermiculite:			
Perlite Producers, Inc	Midland, Tex	Mine and exfoliating plant.	Llano.
Texas Vermiculite Co	Dallas, Tex	Exfoliating plant	Bexar and Dallas.
Vermiculite Products, Inc	Houston, Tex	do	Harris.
Volcanic ash (pumicite): Pozzolana Corp.	Mission, Tex	Mine and plant	Starr.

The Mineral Industry of Utah

This chapter has been prepared under a cooperative agreement for collecting mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Utah Geological and Mineralogical Survey.

By Douglas H. Hileman[1] and William C. Henkes[2]

The value of 1968 mineral production in the State was $424.0 million, $69.5 million (20 percent) more than that of 1967 and $24.9 million less than the record high of $448.9 million in 1966. Production in the metals group was low for the second consecutive year because of a labor strike which lasted until March 30 in the copper and certain segments of the lead-zinc industries. Although the value of the output in the metals group was 32 percent higher than in 1967, it was 4 percent less than the 1966 figure.

The value of mineral-fuels production increased $2.3 million (2 percent). Asphalt (gilsonite), coal, natural gas, and natural gas liquids gained in value, whereas petroleum and carbon dioxide recorded losses.

Values in the nonmetals group increased for 13 of the 17 commodities and decreased for four. Output and value of phosphate rock decreased substantially; although potassium-salts output increased slightly, value decreased sharply. These decreases in value effected a slight loss for the nonmetals group.

A total of 122.3 million tons of material was handled in the metals and nonmetals industries—49.6 million tons of valuable material, 64.5 million tons of leach material, and 8.2 million tons of waste material. Only 3.5 million tons of this total were mined from underground operations. The average value of ore mined by surface mining was $5.48 per ton; the average for underground ore was $15.72 per ton.

Construction work on ponds, canal flumes, pumping stations, and canal systems was completed at the Great Salt Lake Minerals & Chemicals Corp. (GSL) plant near Ogden. GSL is 51 percent owned by Lithium Corporation of America, Inc., a subsidiary of Gulf Resources & Chemical Corp. Total cost of the facilities is estimated at $30 million. Pumping into the solar pond system began in April. According to Gulf Resources' annual report the processing plant will be completed during the third quarter of 1970; production and sales will commence in 1971. Projections indicate an annual production of 240,000 tons of potassium sulfate, 150,000 tons of sodium sulfate, and more than 200,000 tons of magnesium chloride. Company officials signed a 15-year contract to supply The Dow Chemical Co. with 100,000 to 200,000 tons of magnesium chloride annually.

An agreement was reached between Magnesium Project and Utah Power & Light Co. to supply power to the proposed project facilities on the west side of Great Salt Lake at the rate requested by the company of 3.1 mills per kilowatt-hour. The arrangement provides for interruptible power with no specific availability guarantee.

Employment and Injuries.—Final employment and injury data for 1967 and preliminary data for 1968, excluding all mineral fuels except the coal and asphalt (gilsonite) industries, compiled by the Bureau of Mines are shown in table 4.

Legislation and Government Programs.—Research personnel of Kennecott Copper Corp. and the Bureau of Mines in Salt Lake City Metallurgy Research Center developed an ion-exchange process to re-

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[1] Mining engineer, Bureau of Mines, Salt Lake City, Utah.

[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1.—Mineral production in Utah[1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Carbon dioxide (natural)..........thousand cubic feet..	65,664	$5	57,747	$4
Clays..........thousand short tons..	[2] 114	[2] 288	[3] 160	[3] 476
Coal (bituminous)..........do....	4,175	24,281	4,316	24,893
Copper (recoverable content of ores, etc.).....short tons..	168,609	128,905	228,245	191,027
Fluorspar..........do....	W	W	8,762	213
Gem stones..........	NA	80	NA	83
Gold (recoverable content of ores, etc.)......troy ounces..	288,350	10,092	334,419	[4] 13,129
Iron ores (usable)......thousand long tons, gross weight..	1,708	11,916	1,764	11,281
Lead (recoverable content of ores, etc.).......short tons..	53,813	15,068	45,205	11,945
Lime..........thousand short tons..	169	3,182	174	3,439
Natural gas (marketed)..........million cubic feet..	48,965	6,463	46,151	7,292
Petroleum (crude)..........thousand 42-gallon barrels..	24,048	63,221	23,504	62,826
Pumice..........thousand short tons..	W	W	8	19
Salt..........do....	403	3,525	405	3,756
Sand and gravel..........do....	9,412	8,631	10,293	9,364
Silver (recoverable content of ores, etc.) thousand troy ounces..	4,875	7,556	5,121	10,982
Stone..........thousand short tons..	1,831	4,108	1,953	4,312
Uranium (recoverable content U_3O_8)...thousand pounds..	1,287	[5] 10,300	1,712	[6] 13,175
Vanadium..........short tons..	471	2,024	563	2,010
Zinc (recoverable content of ores, etc.)..........do....	34,251	9,483	33,153	8,951
Value of items that cannot be disclosed: Asphalt and related bitumens, cement, clays (fire clay 1967, halloysite), gypsum, magnesium chloride, molybdenum, natural gas liquids, perlite (1967), phosphate rock, potassium salts, pumice, pyrites, tungsten and values indicated by symbol W..........	XX	[7] 45,349	XX	[8] 44,774
Total..........	XX	354,477	XX	423,951
Total 1957–59 constant dollars..........	XX	[r] 310,579	XX	[p] 351,648

[p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fire clay and halloysite; included with "Value of items that cannot be disclosed."

[3] Excludes halloysite; included with "Value of items that cannot be disclosed."

[4] Based on average U.S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968, and the New York selling price for the remainder of the year.

[5] Estimated based on $8.00 per pound f.o.b. mill.

[6] Estimated based on $8.00 per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 per pound for commercial sales.

[7] Value of metals and mineral fuels, $22,456,000; value of nonmetals, $22,891,000.

[8] Value of metals and mineral fuels, $24,306,000; value of nonmetals, $20,468,000.

cover uranium and a solvent-extraction process to recover alumina from the waste-dump liquors used for copper leaching at the Bingham Canyon mine. A pilot plant will be constructed at a segregated test dump to determine whether continuous extraction of uranium is feasible. Large amounts of uranium could be produced at the precipitation plant which now recovers 400,000 pounds of copper per day.

In 1968 Utah awarded $39.1 million for highway construction—$29.1 million for Interstate contracts, $8.9 million for Federal-Aid Primary and Secondary (ABC) contracts, and $1.1 million for 100-percent State-financed contracts. Plans in 1969 are for a 173-percent increase in contract value, totaling $106.5 million—$88 million for Interstate, $16.8 million for ABC, and $1.7 million for State financed.[3] This should increase the demand for cement, stone, and sand and gravel in 1969.

According to the Utah Highway Department, a total of 9.7 miles of Interstate freeway was opened to traffic in 1968. The highway department schedule calls for 89.1 miles to be opened in 1970; 145.1 in 1971; 82.3 in 1972; 138.6 in 1973; 93.1 in 1974; and 71.9 in 1975.

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[3] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1969 . . . and Budgets for Maintenance: Highway Award Plans Up 47% as '69 Federal-Aid Work Soars. V. 182, No. 14, Apr. 3, 1969, pp. 52–53.

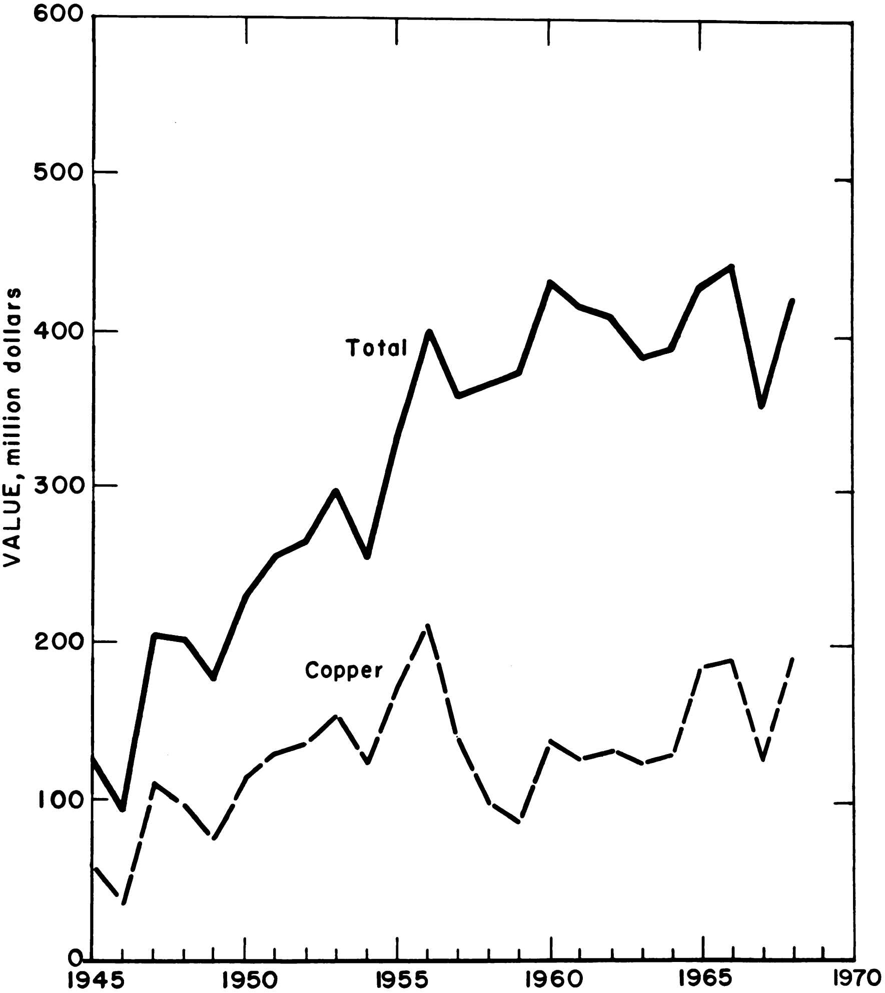

Figure 1.—Value of mine production of copper, and total value of mineral production in Utah.

Table 2.—Value of mineral production in Utah, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Beaver	$2,189	$1,565	Copper, sand and gravel, silver, lead, pumice, zinc, gold.
Box Elder	1,175	1,421	Sand and gravel, lime, salt, stone.
Cache	516	W	Sand and gravel, stone, lime.
Carbon	18,630	18,621	Coal, natural gas, sand and gravel, carbon dioxide.
Daggett	331	132	Natural gas, petroleum, sand and gravel.
Davis	363	651	Sand and gravel, stone.
Duchesne	1,005	2,358	Petroleum, sand and gravel, natural gas.
Emery	[r] 6,111	6,694	Coal, sand and gravel, uranium, natural gas, vanadium, petroleum.
Garfield	1,300	2,844	Petroleum, sand and gravel, uranium, vanadium.
Grand	9,004	7,876	Potassium salts, natural gas, uranium, petroleum, vanadium, sand and gravel.
Iron	12,219	11,679	Iron ore, sand and gravel, coal, pumice, stone.
Juab	1,209	1,532	Clays, fluorspar, stone, silver, gold, copper, lead, zinc, sand and gravel.
Kane	56	104	Sand and gravel, coal.
Millard	W	30	Sand and gravel.
Morgan	W	W	Cement, stone, sand and gravel.
Piute	358	425	Zinc, silver, lead, sand and gravel, uranium, copper, gold, clays.
Rich	W	W	Phosphate rock, sand and gravel.
Salt Lake	171,873	238,831	Copper, molybdenum, gold, silver, lead, zinc, cement, sand and gravel, salt, lime, stone, clays, tungsten concentrate.
San Juan	56,513	58,464	Petroleum, uranium, natural gas, LP gases, vanadium, natural gasoline, copper, stone, sand and gravel, silver.
Sanpete	122	130	Sand and gravel, salt, clays, natural gas.
Sevier	1,366	1,585	Gypsum, coal, clays, sand and gravel, salt, zinc, lead, silver.
Summit	5,685	8,096	Petroleum, zinc, lead, silver, sand and gravel, clays, stone, copper, natural gas, gold, coal, pyrites.
Tooele	8,147	6,980	Lime, salt, stone, lead, sand and gravel, zinc, silver, magnesium chloride, copper, clays, gold, pyrites.
Uintah	27,621	26,615	Petroleum, gilsonite, natural gas, phosphate rock, LP gases, natural gasoline, sand and gravel.
Utah	10,855	8,971	Zinc, lead, stone, silver, sand and gravel, clays, lime, copper, gold.
Wasatch	6,803	6,607	Gold, lead, silver, zinc, copper, sand and gravel, stone.
Washington	405	122	Sand and gravel, silver, copper, stone, gold, petroleum.
Wayne	W	W	Sand and gravel, uranium.
Weber	W	774	Sand and gravel.
Undistributed [1]	10,617	10,843	
Total [2]	354,477	423,951	

[r] Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Utah business activity

		1967 [r]	1968 [p]	Change (percent)
Employment and labor force, annual average:				
Total labor force	thousands	406.1	412.1	+1.5
Total employment	do	383.2	389.2	+1.6
Total unemployment	do	19.9	21.4	+7.5
Total agricultural employment	do	13.8	13.3	—3.6
Total nonagricultural employment	do	369.4	375.9	+1.8
Mining	do	10.3	10.8	+4.9
Contract construction	do	13.4	13.4	--------
Manufacturing	do	50.3	51.7	+2.8
Government	do	98.4	99.4	+1.0
Trade	do	71.6	73.5	+2.7
Service and miscellaneous	do	48.3	50.8	+5.2
All other	do	77.1	76.3	—1.0
Personal income:				
Total	millions	$2,667.0	$2,906.0	+9.0
Per capita		$2,609	$2,810	+7.7
Construction activity:				
Cement shipments to and within the State	thousand 376-pound barrels	1,894.9	2,057.3	+8.6
Total construction valuation	millions	$263.3	$237.8	—9.7
Residential	do	$78.3	$77.4	—1.2
Nonresidential	do	$98.6	$97.4	—1.2
Highway construction contracts awarded	do	$52.9	$39.9	—24.6
Farm marketing receipts	do	$190.6	$190.4	—.1
Mineral production	do	$354.5	$424.0	+19.6
Utility sales or consumption	million kilowatt-hours	5,772.8	6,340.1	+9.8
Total State revenue	millions	$326.1	$401.9	+23.2

[p] Preliminary. [r] Revised.

Source: Bureau of Economic and Business Research, University of Utah, Salt Lake City, Utah.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	1,240	211	262	2,054	-------	106	51.60	3,228
Metal	5,313	215	1,140	9,123	4	196	21.92	3,517
Native asphalt	222	248	55	440	-------	23	52.25	5,306
Nonmetal	1,008	266	268	2,147	-------	113	52.62	1,750
Sand and gravel	598	205	122	1,008	1	24	24.80	6,796
Stone	401	261	105	836	1	11	14.35	7,326
Total [1]	8,782	222	1,952	15,610	6	473	30.69	3,702
1968: [p]								
Coal	1,205	215	259	2,019	2	104	52.50	7,746
Metal	5,190	260	1,351	10,810	3	219	20.54	2,598
Native asphalt	237	247	59	470	-------	15	31.92	730
Nonmetal	980	272	270	2,159	-------	136	62.98	1,054
Sand and gravel	590	192	113	931	-------	20	21.48	7,030
Stone	375	259	97	775	1	5	7.74	7,883
Total [1]	8,580	250	2,148	17,164	6	499	29.42	3,487

[p] Preliminary.

[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

METALS

Beryllium.—Nearly one-half of the construction work was completed on The Brush Beryllium Co. $10 million mill near Delta. The mill will process 500 tons of ore per day. Officials expected mine production to begin in March 1969; the ore is to be stockpiled at the mine until mill operations are started in July. The mine near Spor Mountain will be operated first by open-pit methods and later by underground methods. The beryllium oxide from the mill is to be shipped to Elmore, Ohio, for further metallurgical processing. The U.S. Economic Development Administration approved a grant of $899,500 to pay for one-half of the cost of the 52-mile road between the mine and mill. Exploration and development continued on the property of Topaz Beryllium Co. also near Spor Mountain.

Copper.—The output of copper increased 35 percent in quantity and 48 percent in value. Utah ranked second to Arizona in output. The open-pit mine of the Utah Copper Division of Kennecott Copper Corp. was again the largest copper-producing mine in the Nation.

Other leading copper-producing mines were the OK mine of Toledo Mining Co., the U.S. and Lark mine of United States Smelting Refining and Mining Co. (USSR&M Co.), the Mayflower mine of Hecla Mining Co., and the Big Indian mine of Cliffs Copper Corp. Copper was produced from 25 mines in 10 counties.

An oxygen plant was under construction near the Garfield smelter of Utah Copper. The plant will supply 250 tons of oxygen per day to increase the capacity of the converters and thus produce additional smelter capacity. Since sulfur dioxide is recovered from the converters and not from the reverberatory furnaces, the process will also reduce the emission of sulfur dioxide to the atmosphere.

Gold.—Value of gold production was up $3 million (30 percent) because of higher market values for gold and increased production from the Utah Copper Bingham Canyon mine. Gold, obtained principally as a byproduct from copper and lead-zinc ores, was produced from 23 mines.

Iron Ore.—Iron ore production was from six open-pit mines, all in Iron County: the Blowout, Comstock, and Duncan mines operated by Utah Construction & Mining Co. for CF&I Steel Corp. (CF&I); the Desert Mound mine of United States Steel Corp. (USS); and the Iron Springs and McCahill-Thompson Alluvial mines of Utah Construction & Mining Co. The direct shipping ore and concentrate, averaging 53.4 percent iron, were used almost entirely in producing pig iron and steel; a small amount was used for cement and paint.

The Geneva Works of USS received the contract to supply large-diameter pipe for the 600-mile natural gas pipeline from Texas to California. With this additional demand for steel, 300 employees laid off previously are to be recalled at the Geneva plant as the pipe order goes into production. The Ironton plant of USS,

Table 5.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals[1]

Year	Mines producing		Material sold or treated[2] (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1964	28	--------	25,279	287,674	$10,069	4,552	$5,886
1965	34	--------	32,887	426,299	14,921	5,636	7,287
1966	33	--------	34,459	438,736	15,356	7,755	10,028
1967	22	1	21,537	288,350	10,092	4,875	7,556
1968	32	--------	29,501	331,419	13,129	5,121	10,982
1864–1968	NA	NA	[3] 1,196,036	18,826,793	560,589	851,188	662,738

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1964	199,588	$130,131	40,249	$10,545	31,428	$8,548	$165,179
1965	259,138	183,470	37,700	11,762	27,747	8,102	225,542
1966	265,383	191,978	64,124	19,385	37,323	10,824	247,571
1967	168,609	128,905	53,813	15,068	34,251	9,483	171,104
1968	228,245	191,027	45,205	11,945	33,153	8,951	236,034
1864–1968	9,934,135	4,395,653	5,435,741	773,564	1,785,091	345,070	6,737,614

NA Not available.

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated; and ore, old tailings or copper precipitates shipped to smelters during the calendar year indicated.

[2] Does not include gravel washed or tonnage of precipitates shipped.

[3] Figures estimated for certain years before 1901.

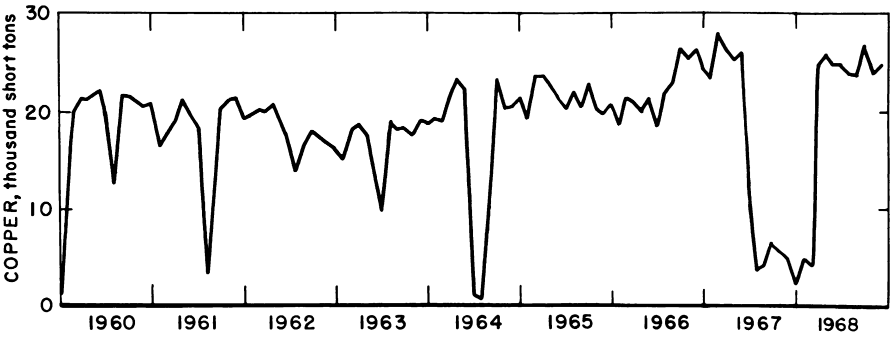

Figure 2.—Mine production of copper in Utah, by months in terms of recoverable metals.

Table 6.—Mine production of gold, silver, copper, lead, and zinc in 1968, by counties, in terms of recoverable metals

County	Mines producing [1]	Lode material sold or treated [2]	Gold		Silver	
	(lode)	(thousand short tons)	Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
Beaver	6	[3] 226	[3] 359	[3] $14	[3] 755,886	[3] $1,621
Juab	2	23	667	26	49,650	106
Piute	1	(3)	(3)	(3)	(3)	(3)
Salt Lake	5	28,703	272,390	10,694	3,246,437	6,962
San Juan	3	266	----------	----------	9,973	21
Sevier	1	(4)	----------	----------	17	(4)
Summit	5	122	1,807	71	337,603	724
Tooele	6	32	167	7	168,255	361
Utah	1	(3)	(3)	(3)	(3)	(3)
Wasatch	1	122	59,028	2,317	543,600	1,166
Washington	1	5	1	(4)	9,351	20
Total [5]	32	29,501	334,419	13,129	5,120,772	10,982

County	Copper		Lead		Zinc		Total value [5] (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Beaver	[3] 1,830	[3] $1,531	[3] 9,782	[3] $2,585	[3] 10,152	[3] $2,741	$8,492
Juab	20	17	8	2	2	1	153
Piute	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Salt Lake	224,173	187,620	23,354	6,171	12,267	3,312	214,759
San Juan	1,024	857	----------	----------	----------	----------	878
Sevier	-------	----------	(4)	(4)	4	1	1
Summit	101	85	4,781	1,263	5,487	1,481	3,624
Tooele	131	109	2,599	687	1,715	463	1,627
Utah	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Wasatch	964	807	4,681	1,237	3,526	952	6,479
Washington	2	2	----------	----------	----------	----------	22
Total [5]	228,245	191,027	45,205	11,945	33,153	8,951	236,035

[1] Operations at slag dumps and old mill or miscellaneous cleanups not counted as producing mines; various uranium mines from which copper was recovered as a byproduct not included as they are in the mine count of uranium.

[2] Does not include gravel washed, tonnage of precipitates shipped, or uranium ore milled.

[3] Production of Beaver, Piute, and Utah Counties combined to avoid disclosing individual company confidential data.

[4] Less than ½ unit.

[5] Data may not add to totals shown because of independent rounding.

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1968, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (thousand short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode ore:							
Dry gold-silver	4	118	1,045	14,018	732	17	4
Dry silver	3	24	679	54,692	43	10	7
Total [2]	7	142	1,724	68,710	775	27	12
Copper	6	28,745	264,731	2,254,482	351,718	---------	---------
Copper-lead-zinc	2	122	59,028	543,652	1,928	9,368	7,052
Lead	6	(3)	74	4,605	2	93	18
Lead-zinc	11	484	8,165	2,173,381	2,847	80,550	58,420
Zinc	1	(3)	---------	17	---------	1	8
Total [2]	26	29,302	331,998	4,976,137	356,495	90,006	65,498
Other lode material:							
Silver tailings	2	28	651	54,857	43	---------	---------
Copper cleanup, copper tailings, uranium [4]	[5] 1	[6] 21	3	10,006	427	---------	(3)
Copper-lead-zinc cleanup, lead cleanup, lead-mill cleanup [4]	(7)	(3)	32	7,644	5	140	1
Copper precipitates	1	58	---------	-----------	98,731	---------	---------
Lead-zinc cleanup, zinc slag [4]	(7)	8	11	3,418	15	237	795
Total [2]	4	[6] 115	697	75,925	99,220	377	796
Total lode material [2]	32	[6] 29,559	334,419	5,120,772	456,490	90,410	66,306

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Data may not add to totals shown because of independent rounding.
[3] Less than ½ unit.
[4] Combined to avoid disclosing individual company confidential data.
[5] Excludes the mine count of uranium mines from which copper was recovered as a byproduct.
[6] Excludes uranium ore tonnage.
[7] From properties not classed as mines.

Table 8.—Mine production of gold, silver, copper, lead, and zinc in 1968, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Concentration, and smelting of concentrates:					
Ore [1]	331,855	4,605,706	351,585	81,530	63,400
Tailings	---------	5,078	2	---------	---------
Total	331,855	4,610,784	351,587	81,530	63,400
Direct-smelting:					
Ore	1,867	449,114	845	8,503	2,110
Cleanup and old slag	46	11,095	25	377	796
Copper precipitates	---------	-----------	98,731	---------	---------
Tailings	651	49,779	41	---------	---------
Total [2]	2,564	509,988	99,641	8,880	2,906
Other: Leaching of copper ore and copper tailings [3]	---------	-----------	5,262	---------	---------
Grand total	334,419	5,120,772	456,490	90,410	66,306

[1] Includes concentrate from uranium ore.
[2] Data may not add to totals shown because of independent rounding.
[3] Combined to avoid disclosing individual company confidential data.

Table 9.—Usable iron ore shipments

(Thousand long tons and thousand dollars)

Year	Quantity	Value
1964	2,082	$14,306
1965	2,139	14,229
1966	1,956	13,478
1967	1,708	11,916
1968	1,764	11,281
1906–68	78,191	378,620

closed in 1966, has been donated to Brigham Young University for an industrial-park complex.

Lead.—The value of lead output decreased $3.1 million (21 percent). Decreases were reported for the U.S. and Lark mine of USSR&M Co.; the Burgin mine, Tintic Division, Kennecott Copper Corp.; the Mayflower mine, Hecla Mining Co.; and the Ophir mine, USSR&M Co. (McFarland & Hullinger, lessees). Of the five largest producing mines, only United Park City Mines Co. reported an increase in production from the United Park City mines.

Rehabilitation requirements caused by the long strike effecting Kennecott's operations contributed to lower production from the Burgin mine. A 500-ton-per-day concentrator near the mine was virtually completed, and company officials plan to increase the daily mine production to 800 tons in 1969. A new 12- by 6-foot shaft was started in the Trixie area 1½ miles from the mine to examine a mineralized area 750 to 900 feet below the surface.

Officials of the two companies involved agreed to the sale of Keystone Mining Co. properties to United Park City Mines Co. The sale includes 72 acres of important land in a highly mineralized area adjacent to United Park City mines.

Molybdenum.—Output of molybdenum, up 4 percent over that of 1967, came from molybdenum sulfide recovered from copper ore mined at the open-pit mine of Utah Copper.

Selenium.—Recovered as a byproduct of the electrolytic refining of copper by Utah Copper at the Garfield refinery, output of selenium increased 58 percent. It was the largest producer of selenium in the Nation.

Silver.—Although output of silver was up 5 percent, the value increased 45 percent because of higher silver prices. A substantial gain in production of silver at the Utah Copper Bingham Canyon mine more than offset the loss reported by the other mines. Total silver production came from 28 mines in 11 counties.

Uranium.—Production of uranium ore increased 33 percent; and the number of uranium operations increased from 117 to 134. The value of production, however, increased only 28 percent because ore grade dropped from 0.26 to 0.23 percent (4.6 pounds per ton). In addition, value for 1968 was based on $8.00 per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 per pound for commercial sales, compared with the 1967 value based on $8.00 per pound f.o.b. mill.

Table 10.—Mine production of uranium (U_3O_8), by counties, in terms of recoverable content

County	1967			1968		
	Number of operations	Pounds	Value [1] (thousands)	Number of operations	Pounds	Value [2] (thousands)
Emery	17	[3] 52,187	[3] $417	15	[3] 36,453	[3] $285
Garfield	12	11,589	93	19	11,521	92
Grand	21	105,540	844	22	68,333	514
Piute	2	([3])	([3])	4	([3])	([3])
San Juan	64	1,118,138	8,945	73	1,595,332	12,284
Wayne	1	([3])	([3])	1	([3])	([3])
Total [4]	117	1,287,454	10,300	134	1,711,639	13,175

[1] F.o.b. mill value; based on $8.00 per pound of U_3O_8 contained in concentrate.

[2] Value estimated, based on $8.00 per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 per pound for commercial sales; includes value of U_3O_8 obtained from Utah ores processed at out-of-State mills.

[3] Emery, Piute, and Wayne Counties combined to avoid disclosing individual company confidential data.

[4] Data may not add to totals shown because of independent rounding.

Uranium ore from Utah was processed at one plant in Utah—Atlas Minerals Division, Atlas Corp., Moab—and at five out-of-State plants—Climax Uranium Co. Unit, Amax Nuclear Division, American Metal Climax, Inc., Grand Junction, Colo.; Cotter Corp., Canon City, Colo.; Mining and Metals Division, Union Carbide Corp., Rifle and Uravan, Colo.; and Foote Mineral Co., Shiprock, N. Mex.

A fire on Christmas Day caused an estimated $1 million in damage at the Atlas Minerals mill near Moab. It was reported that a burning electrical wire fell into a vat containing kerosine.

Officials of Rio Algom Mines, Ltd., announced that a mine and mill would be constructed on the Humeca property south of Moab to produce 1.2 million pounds of uranium oxide per year. The operation will be developed to supply uranium to Duke Power Co. of Charlotte, N.C., over a 6-year period starting in 1972.

Vanadium.—Although the output of vanadium increased 92 short tons (20 percent), the value showed little change. Vanadium pentoxide is recovered from Utah uranium ores at one mill in Utah, two in Colorado, and one in New Mexico.

In Salt Lake City the vanadium pentoxide mill of Vitro Minerals & Chemical Co. Division, Vitro Corporation of America, was closed July 7 because of the depressed vanadium market. The plant processed slag from the Pocatello, Idaho, plant of FMC Corp.

Zinc.—Zinc production reported from 20 mines in nine counties decreased 3 percent. The five largest producing mines in order of rank were the U.S. and Lark mine of USSR&M Co.; the Burgin mine, Tintic Division; the United Park City mines, United Park City Mines Co.; the Mayflower mine, Hecla Mining Co.; and the Ophir mine, USSR&M Co. (McFarland & Hullinger, lessees).

MINERAL FUELS

Asphalt and Related Bitumens.—Major Oil Co., a Salt Lake City firm, claimed discovery of an economical process for extracting oil from oil-sands. The process combines thermal, chemical, and mechanical methods of extracting oil. By early 1969 the firm expected to be producing 500 barrels of oil per day from a refinery to be located at Vernal.

Carbon Dioxide.—Output of carbon dioxide from the Farnham Dome field, Carbon County, decreased 12 percent from the 65.7 million cubic feet produced in 1967. The decline marked further depletion of the one-well reservoir.

Coal (Bituminous).—Up for the first time since 1965, coal production showed a 3-percent gain in both value and output. Coal was produced at 23 mines in six counties. The combined production of Carbon and Emery Counties accounted for 98 percent of the State's total output. Trucks were used to transport 10 percent of the shipments; 90 percent was shipped by rail.

Table 11.—Coal (bituminous) sold or used,[1] by counties

County	1967		1968	
	Number of mines operating (all underground)	Thousand short tons	Number of mines operating (all underground)	Thousand short tons
Carbon	14	2,971	11	3,062
Emery	6	1,113	8	1,167
Iron	1	3	1	3
Kane	1	2	1	2
Sevier	1	72	1	70
Summit	1	13	1	13
Total [2]	24	4,175	23	4,316

[1] Excludes mines producing less than 1,000 short tons.

[2] Data may not add to total shown because of independent rounding.

A longwall unit was installed at the Sunnyside No. 1 mine because of the good cost record of the unit operating in the Sunnyside No. 3. Other equipment used at the mines in the State included 26 loading machines and 27 continuous mining machines. The continuous mining machines produced 73 percent of the coal; 18 discharged into shuttle cars, seven onto the bottom, and two onto conveyors. A total of six plants was used to clean mechanically 64 percent of the production.

A unit train between Sunnyside and the Fontana, Calif., plant of Kaiser Steel Corp. was first operated in December. Mine and railroad unit train facilities cost $4.5 million. The train, designed to handle 8,400 tons of coal per trip, will be loaded at the mine in little more than 1 hour. The new cost of moving coal to California was reduced to 6 mills per ton-mile.

The Castle Valley mine near Orangeville was closed after two development entries were driven about 7,000 feet into a large undeveloped block of coal. The mine will be reopened as a large operation if a market for the coal is developed.

Natural Gas.—Marketed natural gas was 5.7 percent less than the 49.0 billion cubic feet marketed in 1967. Because of an increase in wellhead value of natural gas, however, the value of marketed gas was 12.8 percent above that of the previous year. The State Division of Oil and Gas Conservation[4] reported gas production of 77.7 billion cubic feet for 1968. San Juan County was the largest gas producer with a yield of 33.9 billion cubic feet; the output, however, from the Lisbon field—22.5 billion cubic feet—was processed for liquids removal and returned to the reservoir for pressure maintenance. Uintah County produced 29.4 billion cubic feet; Greater Red Wash, Horseshoe Bend, and Chapita Wells fields were the principal producers. Grand County ranked third with 9.4 billion cubic feet, mainly from the San Arroyo and Westwater fields.

State and Federal Government agencies received a total of $918,158 in royalties from natural gas production; of this, $557,219 was from production on public domain, $309,393 was from Indian lands, and $51,546 from State lands. Comparable figures for 1967 were, respectively, $487,084, $273,099, and $56,249.[5] The Mineral Leasing Act of 1920 provides that the State will receive 37.5 percent of the royalties paid on production from public domain. These figures do not include royalty revenues derived from production on private lands.

The American Petroleum Institute (API) and the American Gas Association, Inc. (AGA), estimated reserves of natural gas in the State at 1.2 trillion cubic feet. Reserves declined 70 billion cubic feet; new fields and new pools added 204 million cubic feet; and extensions and revisions caused a net loss of 24.4 billion cubic feet.[6]

A U.S. District Court decision early in the year gave Colorado Interstate Corp. the right to purchase from El Paso Natural Gas Co. the facilities of Pacific Northwest Pipeline Corp. In an earlier antitrust decision by the U.S. Supreme Court, El Paso had been ordered to divest itself of Pacific Northwest Pipeline; the pipeline provides an outlet to markets in Washington and Oregon for gas from the Four Corners area, eastern Utah, western Colorado, and southwestern Wyoming. The new company —Northwest Pipeline Corp.—will operate as a wholly owned subsidiary of Colorado Interstate and will maintain operating headquarters in Utah.

Natural Gas Liquids.—Total output of natural gas liquids increased 22 percent because of the first full year of operation of the Lisbon gasoline plant. Owned by Union Oil Company of California, the plant went on stream in July 1967. Production of LP gases increased 27 percent and that of natural gasoline 11 percent. Total production value of natural gas liquids was 16 percent higher than that of 1967. Reserves of natural gas liquids in the State declined 2.3 million barrels to 40.5 million from the 42.7 million barrels estimated as of January 1, 1968.[7]

Petroleum.—Output of crude oil again declined slightly, 2.3 percent from the 24.0 million barrels produced in 1967; newly discovered reserves failed to offset depletion of older reservoirs. With 58 percent of total production, San Juan County maintained its leading position, and Uintah County ranked second with 6.8 million barrels of oil. Summit County's Bridger Lake field increased its output by 51 percent to bring that county to rank third in the State.

Greater Aneth Area, San Juan County, was the largest field in terms of production, with a total of 9.0 million barrels of oil; leading fields within the area were McElmo Creek, Aneth, and Ratherford. The Greater Red Wash Area, Unitah County, ranked

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[4] Utah Department of Natural Resources, Division of Oil and Gas Conservation. Monthly Oil and Gas Production Reports. January–December, 1968.

[5] Utah Department of Natural Resources, Division of Oil and Gas Conservation. Annual Sales and Royalty Report. 1968, 17 pp.

[6] American Gas Association, Inc., American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada as of Dec. 31, 1968. V. 23, May 1969, p. 120.

[7] Page 123 of work cited in footnote 6.

Table 12.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1967	1968	Principal fields in 1968 in order of production
Box Elder	2	--------	
Daggett	3	3	Clay Basin.
Duchesne	215	725	Bluebell, Monument Butte, Duchesne.
Emery	11	9	Grassy Trails, Ferron.
Garfield	432	897	Upper Valley.
Grand	139	135	Salt Wash, Long Canyon, San Arroyo, Agate.
San Juan	15,304	13,604	McElmo Creek, Aneth, Lisbon, Ratherford.
Summit	861	1,301	Bridger Lake.
Uintah	7,081	6,830	Red Wash, Wonsits Valley, Walker Hollow, Ashley Valley.
Washington	------	(1)	Undesignated.
Total	24,048	23,504	

[1] Less than ½ unit.

Source: Utah Oil & Gas Conservation Commission.

Table 13.—Oil and gas well drilling in 1968, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Carbon	-----	-----	8	8	41,269
Daggett	-----	-----	1	1	2,047
Duchesne	-----	-----	2	2	8,235
Emery	-----	-----	2	2	12,835
Garfield	-----	-----	2	2	13,822
Grand	-----	-----	6	6	5,957
Kane	-----	-----	1	1	6,425
Millard	-----	-----	4	4	22,414
San Juan	2	-----	15	17	103,840
Sevier	-----	-----	1	1	3,050
Summit	-----	-----	3	3	39,510
Uintah	-----	-----	7	7	30,800
Washington	1	-----	2	3	12,642
Wayne	-----	-----	1	1	6,026
Total	3	-----	55	58	307,872
Development completions:					
Duchesne	5	-----	-----	5	54,509
Garfield	6	-----	-----	6	41,870
Grand	-----	3	15	18	36,597
San Juan	8	-----	15	23	91,373
Summit	2	-----	-----	2	31,525
Uintah	24	5	6	35	181,894
Washington	-----	-----	1	1	750
Total	45	8	37	90	438,518
Total all drilling	48	8	92	148	746,390

Source: Adapted from Petroleum Information Corp., 1968 Resumé, Oil and Gas Operations in the Rocky Mountain Region.

second with a yield of 6.2 million barrels; its principal fields were Red Wash Unit, Wonsits Valley, and Walker Hollow. Lisbon field, San Juan County, was third with annual production of 3.0 million barrels. Bridger Lake field, Summit County, with an output of 1.3 million barrels, was fourth. The Upper Valley field, Garfield County, with 11 wells, had a yield (897,072 barrels) more than double that of 1967.

Estimated reserves of crude oil in the State as of January 1, 1969 were 180 million barrels, 21 million barrels less than in the previous year. Addition to reserves from new field discoveries was 240,000 barrels; change resulting from extensions and revisions was a net gain of 2.2 million barrels. These gains, however, did not offset the 23.5 million barrels of production.[9]

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[9] Pages 26–27 of work cited in footnote 6.

Table 14.—Oil and gas discoveries in 1968

County and field	Well	Operator	Location		
			Section	Township	Range
San Juan:					
Wilson Canyon	No. 1 Chevron Federal.	Gulf Oil Corp	24	29 S	23 E
Cowboy	No. 1 Cowboy.	Mountain Fuel Supply Co	14	39 S	22 E
Washington: Anderson Junction	No. 1 Federal.	Willard Pease Drilling Co	25	40 S	13 W

County and field	Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks
				Barrels of oil per day	Thousand cubic feet of gas per day		
San Juan:							
Wilson Canyon	Paradox	8,460–8,482	9,955	147	299	May 9	Flowing.
Cowboy	Lower Ismay	5,759–5,800	6,031	382	200	July 18	Do.
Washington: Anderson Junction	Pennsylvanian	4,098–4,116 4,210–4,224	5,236	10	---	Feb. 21	Pumping.

Sources: Petroleum Information Corp., 1968 Resumé, Oil and Gas Operations in the Rocky Mountain Region. Utah Department of Natural Resources, Division of Oil and Gas Conservation, Yearly Well Completion Report, January through December 1968, 26 pp.

Royalties paid to State and Federal Government agencies from crude oil production amounted to $7,500,511, a decline of $1,163,451 (13.4 percent) from that received in 1967. Of the total paid in 1968, $4,363,170 was for production on Indian lands, $2,823,614 from public domain, and $313,727 from State land.[9] As with natural gas, these sums do not include royalties paid for production on private land; moreover, 37.5 percent of the royalties received from public domain was to be returned to the State.

Competitive leasing for Federal, State, and Indian lands resulted in the leasing of 135,106 acres for which a total bonus of $1,081,698 was paid. Indian lands of the Uintah and Ouray Agency received the highest average bids; the highest bid was $127.79 per acre.

Overall drilling during the year was eight wells more than the 140 drilled in 1967; there were five more development wells and three additional exploratory wells. With completion of 26 new oil wells, the Wonsits Valley field had the most active development drilling program. The Bluebell field, Duchesne County, had seven successful field wells completed. The success ratio of exploratory drilling was 5.2 percent, compared with 12.7 percent in 1967. Although one of the three discoveries was very small—10 barrels of oil per day—it possibly had regional significance.

Two of the discoveries were in San Juan County. Mountain Fuel Supply Co., Cowboy No. 1 well, NW¼ SW¼ sec 14, T 39 S, R 22 E, discovered the Cowboy field, when it was successfully completed for a flow gage of 382 barrels of oil per day from the Lower Ismay zone of the Paradox Formation (Pennsylvanian); unfortunately, two offset wells were dry. The Wilson Canyon field was discovered by Gulf Oil Corp., when its Chevron-Federal No. 1, SE¼ NE¼ sec 24, T 29 S, R 23 E, was completed for a daily flow gage of 147 barrels of oil and 299,000 cubic feet of gas from the Cane Creek zone of the Paradox Formation.

The third discovery, in Washington County, was significant because of its distance from proven and active oil areas. The discovery was about 6 miles northwest of the old Virgin field which had produced from the Moenkopi Formation (Triassic). The well, Buttes Gas & Oil Co. and others, Federal No. 1, SW¼ NE¼ sec 25, T 40 S, R 13 W, was completed, pumping 10 barrels of oil per day from the Pennsylvanian.

Runs to stills in the State's five oil refineries amounted to 36.7 million barrels. Of this, 10.3 million barrels were from State sources, and 26.4 million were from out-of-State. Principal sources for the imported crude oil were Colorado with 18.4 million barrels and Wyoming with 7.7 million. Out-of-State shipments were chiefly to California (8.9 million barrels) and Texas (2.5 million barrels).

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[9] Work cited in footnote 5.

NONMETALS

Barite.—No production of crude barite was reported in Utah during 1968. An increase however was reported in the amount of barite ground by Yuba Minerals & Milling Co., Salt Lake City.

Cement.—Portland cement was produced by Ideal Cement Co. at Devil's Slide in Morgan County and by Portland Cement Company of Utah at Salt Lake City. A small quantity of masonry cement was produced by Ideal Cement Co. Output of portland cement increased 12 percent in quantity and 12 percent in value. About 70 percent of the production was used by ready-mixed-concrete companies.

Clays.—Clays were produced at 15 operations in eight counties. Output of bentonite, fuller's earth, and miscellaneous clays recorded a 30-percent increase for a gain of 34,000 short tons.

The major use of clay was as a raw material for lightweight aggregate, followed by the manufacturing of building brick, and next as a catalyst in oil refining.

Fluorspar.—Used for manufacturing steel and in uranium reduction, output of fluorspar from four operations in Juab County increased substantially.

Gypsum.—Gypsum was produced from open-pit mines near Sigurd in Sevier County by Gypsum Division, Georgia-Pacific Corp., and United States Gypsum Co. Output decreased 2 percent, whereas value of the output increased 26 percent.

Lime.—Lime production came from seven operations; three operators produced lime only for their own use. The principal uses of lime were in copper ore concentration, sugar refining, steelmaking, the phosphate industry, petroleum refining, water purification and softening, and fertilizers.

Magnesium Chloride.—Although other companies have announced plans to produce magnesium chloride, the only production was by Kaiser Aluminum & Chemical Corp. at the Bonneville plant. Output, up 15 percent, was used principally for sugar refining.

Phosphate Rock.—San Francisco Chemical Co., the only company producing phosphate rock, operated mines in Rich and Uintah Counties. Output was down 36 percent. The Vernal Unit was closed on March 31 for the remainder of the year.

Potash.—Although output of potassium salts increased 6 percent, output value decreased 21 percent. No production was reported by Kaiser Aluminum & Chemical Corp. at its plant near Wendover. The only production was at the Texas Gulf Sulphur Co. (TGS) operation near Moab. According to the annual report of TGS, its division at Cane Creek operated at a financial loss in spite of lower production costs and a 72,000-ton increase in production. By the end of 1968 the crystallizer circuit installed in 1967 was functioning well, resulting in the ability to recover the finer material at lower cost and the improved overall plant recovery to better than 90 percent.

Pumice.—Production of pumice, from three mines in southwestern Utah, increased several times over the 1967 production. It was used mainly as a concrete aggregate.

Pyrites.—International Smelting and Refining Co. shipped pyrites from stockpile; USSR&M Co. produced pyrite concentrate at its Midvale mill from custom ore of United Park City mines. All pyrite was shipped to The Anaconda Company, Yerington, Nev., for manufacturing sulfuric acid.

Salt.—Very little change was reported in the total output of salt. Evaported salt was produced by five companies and rock salt by two. Officials of Hardy Salt Co. announced a $100,000 expansion of warehouse and shipping facilities at the Lakepoint plant. A new $50,000 crusher installed at the rock salt mine of Redmond Clay & Salt Co., Inc., will increase the crushing capacity from 2 to 40 tons per hour.

Sand and Gravel.—Value and output of sand and gravel, from 184 operations in Utah's 29 counties, increased 8 and 9 percent, respectively. The average price per ton for gravel was $0.87 and for sand $1.03. Based on value, sand and gravel was the highest of all nonmetal commodities produced in the State.

Table 15.—Sand and gravel production in 1968, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Beaver	22	$31
Box Elder	873	842
Cache	385	483
Carbon	95	92
Daggett	6	6
Davis	795	642
Duchesne	455	376
Emery	250	262
Garfield	350	354
Grand	36	43
Iron	361	369
Juab	(1)	(1)
Kane	116	94
Millard	30	30
Morgan	W	W
Piute	39	37
Rich	W	W
Salt Lake	3,034	2,809
San Juan	53	53
Sanpete	62	63
Sevier	119	118
Summit	397	394
Tooele	1,008	521
Uintah	135	146
Utah	538	536
Wasatch	132	120
Washington	76	99
Wayne	7	3
Weber	865	774
Undistributed	54	67
Total	10,293	9,364

W Withheld to avoid disclosing individual company confidential data; included in "Undistributed."

[1] Less than ½ unit.

Stone.—Output of stone increased 7 percent in quantity and 5 percent in value. The five leading limestone-producing companies in order of output were Ideal Cement Co., USS, Portland Cement Company of Utah, The Flintkote Co., and Le Grand Johnson Corp. The producers of dolomite were USS and Utah Marblehead Lime Co.

Table 16.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	951	$1,105	799	$876
Paving	203	219	352	395
Railroad ballast	24	20	[1] 115	[1] 166
Fill	128	64	83	36
Other	[2] 45	[2] 76	(1)	(1)
Industrial:				
Molding	(2)	(2)	--------	--------
Blast	(2)	(2)	(1)	(1)
Fire or furnace	(2)	(2)	--------	--------
Engine	(2)	(2)	(1)	(1)
Foundry (ground)	--------	--------	(1)	(1)
Other	--------	--------	(1)	(1)
Total	1,351	1,484	1,349	1,473
Gravel:				
Construction:				
Building	1,241	1,216	1,074	1,012
Paving	1,138	1,089	2,051	2,061
Railroad ballast	18	15	15	6
Fill	260	136	442	225
Miscellaneous	84	88	73	79
Total	2,741	2,544	3,655	3,383
Total sand and gravel	4,092	4,028	5,004	4,856
Government-and-contractor operations:				
Sand:				
Building	--------	--------	12	12
Paving	485	427	1,108	1,080
Fill	129	111	50	25
Other	--------	--------	19	17
Total	614	538	1,189	1,134
Gravel:				
Building	86	43	154	181
Paving	4,147	3,707	3,653	3,045
Fill	473	315	292	147
Other	--------	--------	1	1
Total	4,706	4,065	4,100	3,374
Total sand and gravel [3]	5,320	4,605	5,289	4,510
All operations:				
Sand	1,965	2,022	2,538	2,607
Gravel	7,447	6,609	7,755	6,757
Total	9,412	8,631	10,293	9,364

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[1] "Other (construction)," blast, foundry, and "Other (industrial)" sand combined with railroad ballast sand to avoid disclosing individual company confidential data.

[2] Molding blast, fire or furnace, and engine sand combined with "Other (construction)" sand to avoid disclosing individual company confidential data.

[3] Data may not add to total shown because of independent rounding.

Table 17.—Stone production in 1968, by counties

County	Short tons	Value (thousands)
Box Elder	3,544	$92
Cache	111,882	294
Davis	4,026	9
Iron	W	W
Juab	W	W
Morgan	W	W
Salt Lake	W	W
San Juan	28,522	57
Summit	82,714	178
Tooele	312,992	748
Utah	W	W
Wasatch	346	8
Washington	W	W
Undistributed	1,409,074	2,926
Total	1,953,100	4,312

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Table 18.—Stone sold or used by producers, by uses

Use	1967		1968	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction......short tons	W	W	346	$8,000
Rubble......do	------------	------------	W	W
Rough architectural......cubic feet	W	W	W	W
Sawed stone......do	r 22,038	$94,410	19,209	74,103
Cut stone......do	------------	------------		
Flagging......do	8,794	21,515	7,301	24,875
Total (approximate, in short tons)	3,600	141,855	4,400	122,289
Crushed and broken stone:				
Riprap and jetty stone...short tons	90,556	201,121	83,802	166,329
Metallurgical......do	858,469	1,945,199	(1)	(1)
Roofing aggregates......do	150	900	1,228	8,300
Concrete and roadstone......do	(1)	(1)	118,313	280,797
Concrete aggregate......do	NA	NA	1,097	22,806
Dense graded roadbase......do	NA	NA	41,422	82,044
Surface treatment aggregate......do	NA	NA	75,794	175,947
Lime......do	181,537	432,243	343,564	775,961
Other......do	r 2 696,383	r 2 1,386,569	3 1,401,817	3 2,958,623
Total......do	1,827,095	3,966,032	1,948,724	4,190,010
Total stone (approximate, in short tons)	1,830,700	4,107,887	1,953,100	4,312,299

r Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included in "Totals."

[1] Included with "Other" to avoid disclosing individual company confidential data.

[2] Includes stone used in cast stone, cement, coal dust, decorative use, fertilizer filler, foundry, landscaping, mineral food, poultry grit, railroad ballast, roofing gravel, stone sand, and unspecified uses.

[3] Includes stone used in cement, dense graded roadbase, flux, landscaping, mine dusting, other fillers or extenders, poultry grit and mineral food, refractories, terrazzo and exposed aggregate, whiting, and unspecified uses.

Table 19.—Stone sold or used by producers, by kinds[1]

(Thousand short tons and thousand dollars)

Kind of stone	1964		1965		1966		1967		1968	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Dolomite and limestone [2]	2,004	$3,860	1,852	$3,734	1,943	$3,573	1,767	$3,843	1,817	$3,816
Granite	1	160	W	W	-----	-----	-----	-----	-----	-----
Marble	1	17	(3)	11	W	W	-----	-----	-----	-----
Quartz, quartzite, sandstone	968	2,549	202	499	202	447	54	162	126	400
Quartz and quartzite	NA	NA	NA	NA	NA	NA	NA	NA	65	172
Sandstone	NA	NA	NA	NA	NA	NA	NA	NA	62	227
Slate	-----	-----	2	82	1	43	W	W	W	W
Traprock	-----	-----	(3)	1	(3)	(3)	(3)	(3)	(3)	(3)
Other stone [4]	132	343	101	225	101	206	10	102	10	96
Total	3,105	6,930	2,158	4,552	2,246	4,269	1,831	4,108	1,953	4,312

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Other stone."

[1] Data may not add to totals shown because of independent rounding.

[2] Excludes dimension limestone; included with "Other stone."

[3] Less than ½ unit.

[4] Includes dimension limestone and those quantities and values indicated by symbol W.

Table 20.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt and related bitumens:		Underground mine	Uintah.
American Gilsonite Co.	Suite 1150, Kennecott Bldg. Salt Lake City, Utah 84110	Refinery	Mesa County, Colo.
Carbon dioxide (natural):			
Equity Oil Co.	806 American Oil Bldg. Salt Lake City, Utah 84101	Well and plant, Farnham Dome field.	Carbon.
Cement: Ideal Cement Co., a division of Ideal Basic Industries, Inc.	620 Ideal Cement Bldg. Denver, Colo. 80202	Wet-process, 2-rotary-kiln plant.	Morgan.
Clays:			
Filtrol Corp	3250 East Washington Blvd. Los Angeles, Calif. 90023	Open pit-underground mine.	Juab.
International Pipe and Ceramics Corp.	2901 Los Feliz Blvd. Los Angeles, Calif. 90039	Open-pit mine do 2 open-pit mines	Salt Lake. Sevier. Utah.
Interstate Brick Co	Box 6239 Salt Lake City, Utah 84106	Open-pit mine do do	Sevier. Summit. Tooele.
Utelite Corp	R.F.D. Coalville, Utah 84017	Open-pit mine and expanding plant.	Summit.
Western Clay & Metals Co.	5 South Second St. Alhambra, Calif. 91801	2 open-pit mines	Sevier.
Coal (bituminous):			
Kaiser Steel Corp	Sunnyside Coal Mines Sunnyside, Utah 84539	3 underground mines and cleaning and crushing plant.	Carbon.
The North American Coal Corp.	12800 Shaker Blvd. Cleveland, Ohio 44120	2 underground mines and cleaning, thermal drying, and oil treatment plant.	Do.
United States Fuel Co.	Box 1769 Salt Lake City, Utah 84111	Underground mine Cleaning, crushing, and oil treatment plant.	Carbon, Emery. Carbon.
United States Steel Corp., Western District.	Box 807 Dragerton, Utah 84520	Underground mine Cleaning, thermal drying, and crushing plant.	Carbon, Emery. Carbon.
Copper:			
Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	Open-pit mine, crusher, 2 flotation mills, precipitation plant, smelter, and electrolytic refinery.	Salt Lake.
Toledo Mining Co	322 Newhouse Bldg. Salt Lake City, Utah 84111	Open-pit mine and precipitation plant.	Beaver.
United States Smelting Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	See Lead	Salt Lake.
Fluorspar: Willden Fluorspar Co.	Box 536 Delta, Utah 84624	Open pit-underground mine.	Juab.
Gold:			
Hecla Mining Co	Box 320 Wallace, Idaho 83873	Underground mine and flotation mill.	Wasatch.
Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	See Copper	Salt Lake.
United States Smelting Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	See Lead	Do.
Gypsum:			
Georgia Pacific Corp., Gypsum Division.	Box 311 Portland, Oreg. 97207	Open-pit mine; crushing, grinding, and screening plant; calcining equipment; wallboard plant.	Sevier.
United States Gypsum Co.	101 South Wacker Drive Chicago, Ill. 60606	do	Do.
Iron ore:			
CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	3 open-pit mines	Iron.
United States Steel Corp., Western Ore Operations.	Lander, Wyo. 82520	Open-pit mine	Do.
Utah Construction & Mining Co.	Box 649 Cedar City, Utah 84720	2 open-pit mines, mobile crushing and screening plant, and beneficiation plant.	Do.
Lead:			
Hecla Mining Co	Box 320 Wallace, Idaho 83873	See Gold	Wasatch.
International Smelting and Refining Co.	R.F.D. 1 Tooele, Utah 84074	Smelter	Tooele.

Table 20.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Lead—Continued			
Kennecott Copper Corp., Tintic Division.	Box 250 Eureka, Utah 84628	See Zinc	Utah.
United Park City Mines Co	Star Route 1 Heber City, Utah 84032	See Zinc	Summit.
United States Smelting Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	Underground mine and custom flotation mill.	Salt Lake.
		Underground mine	Tooele.
Lime: Utah Marblehead Lime Co	300 West Washington St. Chicago, Ill. 60606	Rotary-kiln plant	Tooele.
Magnesium Chloride: Kaiser Aluminum & Chemical Corp., Bonneville, Ltd., Division.	300 Lakeside Drive Oakland, Calif. 84612	Solar evaporation	Do.
Molybdenum: Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	See Copper	Salt Lake.
Natural gas and petroleum:[1]			
American Oil Co	Box 898 Salt Lake City, Utah 84110	Refinery	Salt Lake.
Belco Petroleum Corp	630 Third Ave. New York, N.Y. 10017	Crude oil wells, White River field.	Uintah.
		Natural gas wells, Chapita Wells field.	Do.
Chevron Oil Co., Western Division.	Box 599, 1700 Broadway Denver, Colo. 80201	Crude oil wells and gas processing plant, Red Wash field.	Do.
		Crude oil wells, Bluebell field.	Duchesne.
		Natural gas wells, Powder Springs and Horseshoe Bend fields.	Uintah.
		Refinery	Salt Lake.
Continental Oil Co	1300 Main St. Houston, Tex. 77001	Crude oil wells, White Mesa and Bluff fields.	San Juan.
El Paso Natural Gas Co	Box 1526 Salt Lake City, Utah 84110	Gas processing plant, Aneth field.	Do.
Getty Oil Co	2330 South Main St. Salt Lake City, Utah 84115	Natural gas wells, East Canyon field.	Grand.
Gulf Oil Corp	Gulf Bldg. Pittsburgh, Pa. 15219	Crude oil wells, Wonsits Valley field.	Uintah.
		Indian Ridge field	Duchesne.
Humble Oil & Refining Co	2000 Classen Center North Oklahoma City, Okla. 73106	Crude oil and natural gas wells, Walker Hollow field.	Uintah.
Monsanto Co., Hydrocarbons & Polymers Division.	800 N. Lindbergh Blvd. St. Louis, Mo. 63116	Crude oil wells, McElmo Mesa field.	San Juan.
Mountain Fuel Supply Co	Box 11368 Salt Lake City, Utah 84111	Crude oil wells, Cowboy field.	Do.
		Natural gas wells, Clay Basin field.	Daggett.
Oil Inc	240 Federated Security Bldg. 72 East Fourth South Salt Lake City, Utah 84111	Natural gas wells, Westwater field.	Grand.
Phillips Petroleum Co., Western Region.	Security Life Bldg. Denver, Colo. 80202	Crude oil wells, Ratherford field.	San Juan.
		Bridger Lake field	Summit.
		Refinery	Salt Lake.
Sinclair Oil & Gas Co	Box 521 Tulsa, Okla. 74102	Crude oil wells, Boundary Butte field.	San Juan.
		Natural gas wells and gas processing plant, San Arroyo field.	Grand.
Superior Oil Co	First City National Bank Bldg. Houston, Tex. 77002	Crude oil wells, McElmo Creek field.	San Juan.
Tenneco Oil Co	Box 2410 Denver, Colo. 80201	Crude oil wells, Upper Valley field.	Garfield.
		Natural gas wells, Clear Creek field.	Carbon.
Texaco Inc	1570 Grant St. Denver, Colo. 80203	Crude oil wells, Aneth and Ismay Flodine Park fields.	San Juan.
		Natural gas wells, Fence Canyon field.	Uintah.

See footnote at end of table.

Table 20.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Natural gas and petroleum—Continued			
Union Oil Company of California.	Box 7600 Los Angeles, Calif. 90055	Crude oil wells and gas processing plant, Lisbon field.	San Juan.
Warren Petroleum Corp	Warren Bldg. Box 1589 Tulsa, Okla. 84110	Gas processing plant	Uintah.
Phosphate rock: San Francisco Chemical Co.	Drawer F Montpelier, Idaho 83254	Underground mine	Rich.
		Open-pit mine and beneficiation plant.	Uintah.
Potassium salts: Texas Gulf Sulphur Co.	200 Park Ave. New York, N.Y. 10017	Underground mine and flotation refinery.	Grand.
Pyrites: United Park City Mines Co.	Star Route 1 Heber City, Utah 84032	See Zinc	Summit.
Salt:			
Hardy Salt Co	Drawer 449 St. Louis, Mo. 63166	Lake brine processing plant.	Tooele.
Morton Salt Co., a division of Morton International, Inc.	110 North Wacker Drive Chicago, Ill. 60606	do	Salt Lake.
Solar Salt Co	340 West 1455 South Salt Lake City, Utah 84115	do	Tooele.
Sand and gravel:			
Dan R. Fogle Sand & Gravel Products.	350 Hardwell Ave. Salt Lake City, Utah 84115	3 pits and 3 plants	Salt Lake.
Construction Materials Corp., Savage Bros., Inc., Division.	R.F.D. 4, Box 611 American Fork, Utah 84003	Pit and plant	Do.
Parson Development Co	5100 South Washington Blvd. Ogden, Utah 84403	Pit and plant	Weber.
Jack B. Parson Construction Co.	250 North 3d East Smithfield, Utah 84335	2 pits and plant	Cache.
		do	Weber.
Gibbons & Reed Co., Concrete Products Co. Division.	41 West Central Ave. Murray, Utah 84107	Pit and plant	Davis.
		do	Salt Lake.
		do	Wasatch.
		do	Weber.
Pioneer Sand and Gravel	3200 West 5400 South Granger Drive Salt Lake City, Utah 84118	do	Salt Lake.
Utah Sand & Gravel Products Corp.	Box 537 Salt Lake City, Utah 84110	3 pits and plants	Do.
Walker Sand & Gravel Co	21 South 10th West Salt Lake City, Utah 84104	Pit and plant	Do.
Selenium: Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	See Copper	Do.
Silver:			
Hecla Mining Co	Box 320 Wallace, Idaho 83873	See Gold	Wasatch.
Kennecott Copper Corp., Tintic Division.	Box 250 Eureka, Utah 84628	See Zinc	Utah.
Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	See Copper	Salt Lake.
United Park City Mines Co	Star Route 1 Heber City, Utah 84032	See Zinc	Summit.
United States Smelting Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	See Lead	Salt Lake, Tooele.
Stone:			
The Flintkote Co., U.S. Lime Division.	2244 Beverly Blvd. Los Angeles, Calif. 90057	Quarry and plant	Tooele.
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	620 Ideal Cement Bldg. Denver, Colo. 80202	do	Morgan.
Le Grand Johnson Corp	Box 248 Logan, Utah 84321	do	Cache.
Portland Cement Company of Utah.	Box 1469 Salt Lake City, Utah 84110	do	Salt Lake.
United States Steel Corp., Western Ore Operations.	Lander, Wyo. 84520	do	Utah.
Utah Marblehead Lime Co	300 West Washington St. Chicago, Ill. 60606	do	Tooele.
Uranium:			
Atlas Corp., Atlas Minerals Division.	Box 1207 Moab, Utah 84532	5 underground mines	Emery.
		Underground mine and Moab custom mill.	Grand.
		5 underground mines	San Juan.
Homestake Mining Co	Box 563 Moab, Utah 84532	Underground mine	Do.
Climax Uranium Co., Amax Nuclear Division, American Metal Climax, Inc.	Box 1629 Grand Junction, Colo. 81501	5 underground mines	Do.

Table 20.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Vanadium:			
Climax Uranium Co., Amax Nuclear Division, American Metal Climax, Inc.	Box 1629 Grand Junction, Colo. 81501	See Uranium	San Juan.
Zinc:			
Hecla Mining Co	Box 320 Wallace, Idaho 83873	See Gold	Wasatch.
International Smelting and Refining Co.	R.F.D. 1 Tooele, Utah 84074	Fuming plant	Tooele.
Kennecott Copper Corp., Tintic Division.	Box 250 Eureka, Utah 84628	Underground mine	Utah.
United Park City Mines Co	Star Route 1 Heber City, Utah 84032	2 underground mines	Summit.
United States Smelting Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	See Lead	Salt Lake, Tooele.

[1] Only principal fields are listed under "Type of activity."

The Mineral Industry of Vermont

By Harold F. York [1]

Mineral production in Vermont during 1968 was valued at $28.7 million, 5 percent more than that of 1967, and almost 5 percent more than the previous record year of 1965. Stone continued as the most valuable mineral commodity produced, accounting for three-fourths of the total. During the year, the value of sand and gravel, stone, and talc all registered increases over that of 1967. Asbestos declined slightly in value of output, as did lime and clay.

Rutland was the principal mineral producing county, followed by Washington, Orleans, Windsor, and Orange Counties, in that order. Each had mineral production valued in excess of $1 million. Grand Isle was the only county reporting no production during the year.

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[1] Supervisory physical scientist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Vermont [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Peat short tons	280	$4	W	W
Sand and gravel thousand short tons	3,718	2,178	3,587	$2,806
Stone do	2,761	20,520	2,536	21,401
Value of items that cannot be disclosed: Asbestos, clays, gem stones, lime, talc and value indicated by symbol W	XX	4,566	XX	4,508
Total	XX	27,268	XX	28,715
Total 1957–59 constant dollars	XX	26,272	XX	p 27,423

p Preliminary. XX Not applicable.

W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Vermont, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Addison	$127	W	Sand and gravel.
Bennington	351	W	Sand and gravel, stone.
Caledonia	W	W	Do.
Chittenden	W	$566	Stone, sand and gravel, lime, clay.
Essex	W	W	Sand and gravel.
Franklin	W	W	Stone, sand and gravel.
Grand Isle	W	------	
Lamoille	W	W	Talc, sand and gravel.
Orange	W	W	Stone, sand and gravel.
Orleans	W	W	Asbestos, sand and gravel, stone.
Rutland	W	W	Stone, sand and gravel.
Washington	W	W	Do.
Windham	W	W	Sand and gravel, talc.
Windsor	W	W	Stone, talc, sand and gravel, peat.
Undistributed	26,790	28,149	
Total	27,268	28,715	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Table 3.—Indicators of Vermont business activity

	1967	1968	Change (percent)
Employment and annual average labor force:			
Total labor force	175,100	178,600	+2.0
Unemployment (percent work force)	4.2	3.4	−19.1
Employment:			
All manufacturing	44,100	43,800	−.7
Durable goods, total	30,150	29,800	−1.2
Lumber/wood products	3,650	3,400	−6.9
Furniture and fixtures	2,000	2,100	+5.0
Stone, clay, glass	3,300	3,300	.0
Primary metals	1,400	1,200	−14.3
Fabricated metal production	650	700	+7.7
Machinery (excluding electrical)	7,550	6,950	−8.0
Electrical equipment	8,550	9,550	+11.7
Transportation equipment	1,700	1,400	−17.7
Instruments	1,350	1,250	−7.5
Nondurable goods, total	13,950	14,000	+.4
Mining and quarrying	1,050	1,050	.0
All nonmanufacturing	126,250	129,900	+2.9
Payroll data: Average weekly earnings in manufacturing	$105.84	$112.67	+6.5
Personal income			
Total .... millions	$1,178	$1,282	+8.8
Per capita	$2,804	p $3,017	+7.6
Construction activity:			
Total construction .... millions	$135.3	$145.4	+7.3
Nonresidential buildings .... do	$47.8	$57.3	+19.9
Residential buildings .... do	$37.9	$45.0	+18.5
Nonbuilding .... do	$49.6	$43.1	−13.3
Cement shipments to Vermont thousand 376-pound barrels	641	722	+12.6
Mineral production .... thousands	$27,268	$28,715	+5.3

p Preliminary.
Sources: Manufacturing Employment, Economic Development Division, Vermont Development Department; Survey of Current Business, U.S. Department of Commerce.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1967:								
Nonmetal and peat	294	289	85	682	--------	15	22.01	726
Sand and gravel	346	191	66	560	-------	10	17.87	341
Stone	1,769	251	445	3,606	-------	125	34.67	745
Total [1]	2,409	247	596	4,847	--------	150	30.95	695
1968: p								
Nonmetal and peat	315	281	89	717	-------	26	36.27	823
Sand and gravel	265	194	52	451	-------	8	17.75	366
Stone	1,715	244	419	3,434	-------	110	32.03	3,267
Total [1]	2,300	243	560	4,602	-------	144	31.29	2,602

p Preliminary.
[1] Date may not add to totals shown because of independent rounding.

Petroleum and natural gas are not produced in Vermont; however, several instances have been reported of "shows" of gas in previous drilling operations. At the end of 1968, the Tagor Exploration Co. of Atlanta, Ga., was in the process of drilling the E. S. Baker No. 1 on Grand Isle.[2] In January 1965, the then deepest test in the State was abandoned at 5,120 feet by the American Petrofina Exploration Co. This test was drilled near Alburg, Grand Isle County.

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[2] Bulletin, American Association of Petroleum Geologists. V. 53, No. 6, 1969, p. 1197.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Asbestos.—In Orleans County, GAF Corporation, Building and Industrial Floor Products Division (formerly General Aniline and Film Corp.), produced chrysotile asbestos from an open cut mine on Belvidere Mountain. Most of the output was shipped to the company's plants in South Bound Brook, N.J.; St. Louis, Mo.; and Dallas, Tex., for the manufacture of asbestos-cement roofing and siding, industrial board, and corrugated sheets. Asbestos papers were made at the company plant at Erie, Pa. Compared with 1967 levels, the tonnage of asbestos declined 4 percent while the value was reduced 3 percent, reflecting slightly higher unit prices. The value is nearly equal to the average annual value for the past 10 years.

Clays.—The only reported clay production in the State occurred in Chittenden County. At Essex Junction, miscellaneous clay was produced for the manufacture of building brick. The value of this output was about 3 percent less than that of 1967. No kaolin production was reported in Addison County.

Gem Stones.—Specimens of semiprecious gem stones were collected from various localities within the State. Among the mineral varieties collected by hobbyists were garnet, graphite, jasper, talc, and picrolite.

Lime.—Compared with 1967, lime production in 1968 declined 42 percent in tonnage and 39 percent in value. Most of the change was in quicklime while hydrated lime remained about the same. The decline in the value of lime production is a furtherance of the overall decline which began prior to World War II. In Chittenden County, the Vermont Associated Lime Industries, Inc., produced crushed limestone for agricultural uses. Quicklime was manufactured for use in the making of paper. The quarry and plant are at Winooski.

Mica, Reconstituted.—Samica Corp., a part of Dielectric Materials and Systems Divisions, Minnesota Mining and Manufacturing Co., used specially delaminated scrap mica in the manufacture of reconstituted sheet mica for use in electrical insulation. The plant is located in Rutland.

Peat.—Reed-sedge peat for the purpose of soil improvement was produced near Barnard, Windsor County. The average price per ton of bulk peat was $12.86, f.o.b. plant; packaged material sold for $15.71 per ton. These prices were unchanged from those of 1967.

Sand and Gravel.—The production of sand and gravel totaled 3.6 million tons, valued at $2.8 million. The total production was about 4 percent less than that of 1967, but the value was almost 29 percent more. The average price per ton was $0.78 compared with $0.59 per ton in 1967. The unit price for sand and gravel produced and sold for commercial purposes was $0.99 per ton compared with $0.98 per ton in 1967. Noncommercial sand and gravel produced through Government-and-contractor operations was valued at $0.40 per ton, $0.05 per ton more than in the previous year. Commercial sand and gravel production totaled 2.3 million tons. Noncommercial operations, through the Vermont Highway Department, accounted for 1.3 million tons. Compared with 1967 levels commercial production increased 67 percent while noncommercial production declined 45 percent because of reduced highway construction. Windsor County was the leading producer, followed by Bennington, Rutland, Orange, and Orleans Counties—each of which produced over 250,000 tons of sand and gravel.

Twenty-six operations were active during the year in addition to 13 pits operated by the Highway Department and two by the U.S. Forest Service. Six operators produced 25,000 tons or less and accounted for only slightly more than 3 percent of the total commercial output. Five operators produced between 25,000 and 50,000 tons during the year, accounting for about 9 percent of the total. Nine operators produced over 50,000 tons but less than 100,000 tons and accounted for 27 percent. Three operators reported production in excess of 100,000 tons but less than 200,000 tons, or 23 percent of the output. There were two operations that produced over 200,000 tons, or 23 percent, but only one producer exceeded 300,000, accounting for the remaining 15 percent of the total sand and gravel output.

Table 5.—Sand and gravel production by Government-and-contractor operations, by counties

(Thousand short tons)

County	1967	1968
Addison	56	26
Bennington	2	43
Caledonia	19	2
Chittenden	36	18
Essex	-------	15
Franklin	45	33
Lamoille	2	6
Orange	5	4
Orleans	30	18
Rutland	438	233
Washington	99	53
Windham	207	43
Windsor	1,395	779
Total	2,334	1,273

Forty-three percent of the commercial sand and gravel production was used for paving purposes, 31 percent was used for building, and 25 percent was used for fill. The remainder was used for miscellaneous purposes, including engine sand. Of the commercially produced material, 1,342,000 tons was processed by washing and screening and sold at an average price of $1.22 per ton. Bank-run sand and gravel sold for an average of $0.62 per ton and totaled 972,000 tons. Virtually all of the Government-and-contractor production of sand and gravel was used for paving, with a small amount used for building purposes.

During the year, commercial producers reported 13 stationary and six portable processing plants. Two portable plants were used in Government-and-contractor operations. All transportation was by truck.

Stone.—The value of stone produced in Vermont during 1968 was $21.4 million which is the second highest year on record, being exceeded only by the 1965 production valued at $21.6 million. Dimension granite was the most valuable stone product, followed by dimension marble. Dimension slate, valued at $2.3 million, accounted for about 16 percent of the total value of dimension stone.

Practically all of the dimension granite was used for monumental purposes, including monuments, gravestones, and mausoleums. Rough dimension granite was valued at $103.40 per ton. Some rough granite blocks, valued at $43.36 per ton, were sold for building purposes. Rubble for foundations, retaining walls, and other construction purposes was valued at $19.38 per ton. A small amount of dressed granite, valued at $68.39 per ton, was used for curbing and flagging.

Crushed and broken granite was used mainly for construction and maintenance purposes. At an average value of $1.77 per ton, 70 percent of the production was used for bituminous and concrete aggregate. The remainder was used for surface treatment aggregate, riprap and jetty stone, and for traction grit. The Kelley Construction Co. was the leading producer, followed by the State Highway Department.

Washington and Orange Counties led the State in granite production, with lesser amounts produced in Windsor and Caledonia Counties.

Crushed and broken limestone was produced for a variety of purposes. Most of the output was used for aggregate and road base stone. Additional large amounts were consumed in the manufacture of whiting, asphalt filler, and other fillers and extenders. The manufacture of paper also consumed a considerable tonnage. Agricultural limestone, poultry grit, and mineral food accounted for a significant part of the production, while lime, abrasives, and terrazzo and exposed aggregate accounted for the remainder. Rutland County was the principal producer of limestone, followed by Franklin and Chittenden Counties. During the year, there was no production of dimension limestone. Production of crushed and broken limestone was reported in Government-and-contractor operations by the Highway Department.

Two commercial limestone producers were in operation in Chittenden County. L. A. Demers Crushed Rock Co. operated a plant near Colchester and Vermont Associated Lime Industries, Inc., operated one near Winooski. In Franklin County, the Swanton Lime Works, Inc., produced crushed limestone at Swanton. Vermarco Ground Products produced limestone near Florence, Rutland County. Also in Rutland County, the White Pigment Corp. crushed limestone near South Wallin.

Crushed and broken limestone for use as roadstone and for aggregate purposes was valued at about $1.25 per ton. Limestone used for lime and agricultural purposes sold for an average of $4.02 per ton, while that used for terrazzo and exposed aggregate sold for $15.56 per ton. Crushed limestone used as fillers in the manufacture of other products sold at prices ranging from $11.87 to $20.40 per ton, depending on use, and averaged $18.77.

Transportation was exclusively by truck

Both dimension and crushed marble were produced in Rutland County, while a small amount of dimension material was produced in Windsor County. More than one-half of the dimension output was for dressed building stone. About 25 percent of the total was for use as monuments. The remainder was used for curbing and flagging, rough architectural work, and for other building purposes. More than 432,000 tons of crushed and broken marble was used for concrete aggregate and roadstone, and for other miscellaneous purposes.

At Proctor, Rutland County, the Vermont Marble Co. produced rough blocks and cut and sawed dimension stone for architectural purposes. In addition, marble was produced for mausoleums and gravestones. Green Mountain Marble, West Rutland, quarried marble for monumental purposes. In Windsor County, the Vermont Marble Co. produced some cut stone at its Rochester quarry.

Dimension marble in rough blocks was valued at $237.50 per ton. Cut and sawed material sold at prices ranging from $47.84 for house stone veneer to $309.29 for monumental stone. Some specialty stone sold for slightly higher unit prices.

All slate production in Vermont was in Rutland County and consisted mainly of dimension stock supplemented by a smaller amount of crushed material. Most of the dimension output was used for curbing and flagging, roofing, structural and sanitary purposes, electrical equipment, floor tile, mill stock, sculpings, and miscellaneous purposes. Some crushed slate was expanded for use as lightweight aggregate.

During the year, 14 slate producers operated 21 quarries for the production of dimension slate. The Mike Taran quarry and the Little Purple Plant, operated by the C. R. Beach Slate Co., were idle. The Patrick Kehoe Estate also was not operative. The Vermont Light Aggregate Corp. expanded slate for lightweight aggregate.

The average price per ton for roofing slate was $100.77. Slate for electrical purposes sold for $480.25, while structural and sanitary slate sold for $131.80 per ton. Flagging was valued at $31.31 per short ton. Other dimension products ranged in price from $10 per ton for veneer stone to an average of $133.68 for floor tile. Crushed and broken slate for use as lightweight aggregate was valued at $6.40 per ton.

In Bennington and Windsor Counties, the Vermont Highway Department produced crushed and broken quartzite for concrete aggregate and roadstone. Also in Windsor County, the Perini Corp. produced traprock for use as dense graded road base stone.

The GAF Corporation, Building and Industrial Products Division, quarried and crushed miscellaneous stone in Orleans County for use as concrete aggregate and for roadstone. In Rutland County, Wilk Bros., Inc., crushed miscellaneous stone for use as bituminous aggregate. The value, per ton, ranged from $0.62 to $1.50.

Virtually all of the stone produced in Vermont during 1968 was transported by truck. Some stone was moved by railroad.

Talc.—Talc production increased 17 percent in tonnage and 14 percent in value. The Vermont Talc Co. recovered crude talc from its mine in Windham for processing in the company's mill at Chester, Windsor County. Windsor Minerals, Inc., operated the Hammondsville underground mine at Reading and processed the material at its mill at Chester. Eastern Magnesia Talc Co. operated the Johnson underground mine at Johnson, Lamoille County. The company's Rousseau Prospect continued to remain idle. Near the end of 1968, Eastern Magnesia Talc Co. became a subsidiary of Engelhard Minerals & Chemicals Corporation of Menlo Park, N.J. Windsor County continued to lead as the principal talc-producing county.

Ground talc was used extensively in the manufacture of roofing, toilet preparations, paper, paint, insecticides, rubber, textiles, plastics, joint cement, wire insulation, and other uses. Crude talc was valued at about $5.25 per ton.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
GAF Corporation Bldg.; Industrial & Floor Products Division.[1]	140 West 51st Street New York, N.Y. 10020	Pit	Orleans.
Clays: Miscellaneous: Densmore Brick Co., Inc.,	Hanover Street Lebanon, N.H. 03766	do	Chittenden.
Lime: Vermont Assoc. Lime Industries.[2]	25 Airport Drive Winooski, Vt. 05404	Plant	Do.
Peat: Kirks Green Mountain Peat	P.O. Box 456 Woodstock, Vt. 05091	Bog	Windsor.
Sand and gravel:			
Brattleboro Sand & Gravel, Inc.	P.O. Box 358 Brattleboro, Vt. 05301	Pit	Windham.
Caledonia Sand & Gravel Co., Inc.	Box 428 St. Johnsbury, Vt. 05819	do	Caledonia, Washington.
Calkins Construction, Inc	Danville, Vt. 05828	do	Orleans.
J. P. Carrara & Sons, Inc	N. Clarendon, Vt. 05759	do	Rutland.
William E. Dailey, Jr	N. Bennington, Vt. 05257	do	Bennington.
L. G. Defelice & Son, Inc	Nettleton Avenue North Haven, Conn. 06473	do	Orange.
S. T. Griswold, Inc	P.O. Box 8 Williston, Vt. 05495	do	Chittenden.
Albert S. Nadeau	Johnson, Vt. 05656	do	Lamoille.
Lawrence Sangravco, Inc	138 Portland Street Johnsbury, Vt. 05819	do	Essex.
Vermont Sand & Gravel Corp	Box 429 Bellows Falls, Vt. 05101	do	Rutland.
Stone:			
Granite (dimension):			
Rock of Ages Corp	Barre, Vt. 05641	Quarry	Orange, Washington, Windsor.
Wells-Lamson Quarry Co., Inc.	102 North Main Street Barre, Vt. 05641	do	Washington.
Woodbury Quarries, Inc	State Street Concord, N.H. 03301	Processing plant.	Do.
Granite (crushed): Kelly Construction, Inc.	102 North Main Street Barre, Vt. 05641	Crushing plant.	Do.
Limestone (crushed):			
L. A. Demers Crushed Rock Co.	Upper Main Street Winooski, Vt. 05404	Quarry	Chittenden.
Swanton Lime Works, Inc	Swanton, Vt. 05488	do	Franklin.
Vermarco Ground Products Division of Vermont Marble Co.	West Rutland, Vt. 05777	do	Rutland.
Marble (dimension):			
Green Mountain Marble, Division of Georgia Marble Co.	do	do	Do.
Vermont Marble Co.[3]	Proctor, Vt. 05765	do	Grand Isle, Rutland, Windsor.
Slate (dimension):			
Fair Haven Slate Co., Inc.[4]	Fair Haven, Vt. 05743	do	Rutland.
Green Mountain Slate Corp	Granville, N.Y. 12832	do	Do.
John G. Hadeka	25 College Street Poultney, Vt. 05764	do	Do.
Hilltop Slate Co	Middle Granville, N.Y. 12849	do	Do.
Rising & Nelson Slate Co., Inc.	Pawlet, Vt. 05761	do	Do.
Somich Brothers	Granville, N.Y. 12832	do	Do.
Taran Brothers, Inc	North Poultney, Vt. 05764	do	Do.
Tatko Brothers Slate Co	Middle Granville, N.Y. 12849	do	Do.
Vermont Structural Slate Co., Inc.	Prospect Street Fair Haven, Vt. 05743	do	Do.
Slate (crushed): Vermont Light Aggregate Corp.	P.O. Box 41 Castleton, Vt. 05735	do	Do.
Traprock (crushed): Perini Corp	73 Mount Wayte Avenue Framingham, Mass. 01701	do	Windsor.
Talc:			
Eastern Magnesia Talc Co	Johnson, Vt. 05656	Underground	Lamoille.
Vermont Talc Co	Chester, Vt. 05143	do	Windham.
Windsor Minerals, Inc	P.O. Box 680 Windsor, Vt. 05089	do	Windsor.

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[1] Also miscellaneous stone.
[2] Also crushed limestone.
[3] Also crushed marble.
[4] Also crushed slate.

The Mineral Industry of Virginia

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Virginia Division of Mineral Resources for collecting information on all minerals except fuels.

By David J. Kusler[1]

Due in large measure to a record-breaking output of coal, together with a moderately higher average unit value for this commodity, the total value of 1968 mineral production in Virginia rose to a new high of $295.7 million. This was 4 percent greater than the $283.7 million reported in 1967, the previous record high value year. With the exception of stone, which declined slightly in output, the production of commodities supplying the construction industries—cement, clays, gypsum, and sand and gravel—was moderately greater in 1968. Mineral fuels produced in the State in addition to coal included natural gas and limited quantities of oil; production of mineral fuels is confined to the southwestern counties. Other mineral commodities produced included aplite, cement (portland and masonry), clays, feldspar, gem stones, gypsum, kyanite, lime, iron ore (pigment material), lead and zinc ore, titanium concentrates (ilmenite and rutile), salt, sand and gravel, and stone (including soapstone and marine shell). Of the total 1968 mineral production value, 64 percent was contributed by fuels and metals, with fuels by far the largest contributor, and 36 percent by nonmetals.

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[1] Chemist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Virginia[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ---- thousand short tons	1,382	$1,623	1,462	$1,714
Coal (bituminous) ---- do	36,721	171,183	36,966	178,946
Gem stones	NA	7	NA	7
Lead (recoverable content of ores, etc.) ---- short tons	3,430	960	3,573	944
Lime ---- thousand short tons	829	10,345	919	11,138
Natural gas ---- million cubic feet	3,818	1,149	3,389	1,013
Petroleum (crude) ---- thousand 42-gallon barrels	3	W	3	W
Sand and gravel ---- thousand short tons	9,863	12,494	10,859	13,644
Soapstone ---- short tons	W	W	3,928	10
Stone ---- thousand short tons	31,324	52,470	31,217	53,533
Zinc[2] (recoverable content of ores, etc.) ---- short tons	18,846	5,088	19,257	5,199
Value of items that cannot be disclosed: Aplite, cement (portland and masonry), feldspar, gypsum, iron ore (pigment material), kyanite, salt, titanium concentrate (ilmenite and rutile), and values indicated by symbol W	XX	28,366	XX	29,515
Total	XX	283,685	XX	295,663
Total 1957–59 constant dollars	XX	295,193	XX	p 296,623

p Preliminary. NA Not available. XX Not applicable.

W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Recoverable zinc valued at the yearly average price of prime western slab zinc, East St. Louis market. Value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

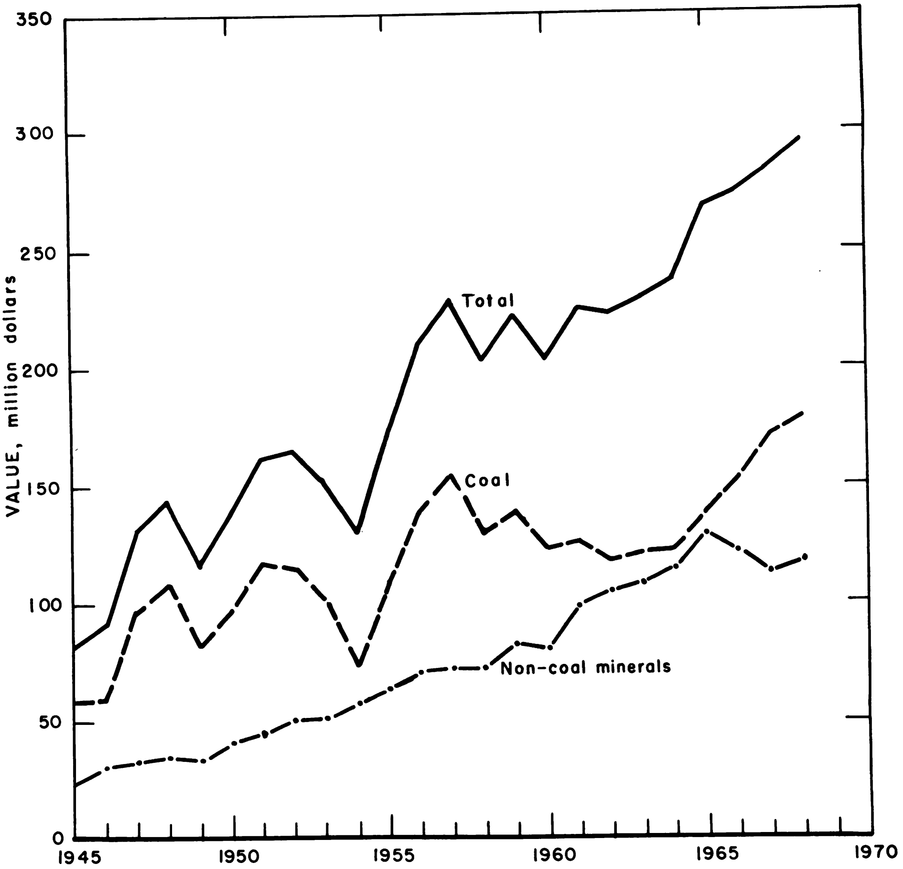

Figure 1.—Value of all minerals except coal, value of coal, and total value of all mineral production in Virginia.

Table 2.—Value of mineral production in Virginia, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Accomack	W	W	Sand and gravel.
Albemarle	W	W	Stone, sand and gravel.
Alleghany	W	W	Do.
Amherst	W	W	Titanium concentrate, sand and gravel.
Appomattox	$79	$75	Stone.
Augusta	5,464	5,610	Cement, stone, sand and gravel, clays.
Bath	W	---------	
Bedford	W	W	Feldspar.
Bland	11	13	Stone.
Botetourt	W	W	Cement, stone, clays.
Brunswick	W	W	Stone, clays.
Buchanan [2]	70,541	77,251	Coal, sand and gravel.
Buckingham	4,586	4,650	Stone, kyanite.
Campbell	1,810	1,275	Stone.
Caroline	W	172	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Virginia, by counties[1]—Continued

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Carroll	W	$14	Stone.
Charles City	W	W	Sand and gravel.
Chesapeake (City)	W	W	Cement, lime, stone.
Chesterfield	W	W	Sand and gravel, stone, clays.
Clarke	W	W	Stone.
Craig	W	---------	
Culpeper	W	W	Stone.
Dickenson	$46,482	45,479	Coal.
Dinwiddie	W	W	Stone, clays.
Essex	W	W	Sand and gravel.
Fairfax	5,209	5,285	Sand and gravel, stone.
Fauquier	W	W	Stone.
Floyd	W	W	Do.
Fluvanna	W	W	Do.
Franklin	W	10	Soapstone.
Frederick	4,195	4,529	Stone, lime, sand and gravel, clays.
Giles	W	W	Lime, stone.
Gloucester	W	W	Sand and gravel.
Goochland	W	2,824	Stone.
Grayson	W	W	Stone, sand and gravel.
Greensville	W	W	Stone.
Halifax	W	W	Stone, sand and gravel.
Hampton (City)	W	W	Sand and gravel.
Hanover	W	W	Stone, aplite, titanium concentrate.
Henrico	3,272	3,168	Sand and gravel.
Henry	W	W	Stone.
Highland	42	W	Stone, sand and gravel.
Isle of Wight	W	102	Sand and gravel, lime.
King William	W	W	Sand and gravel.
Lee[3]	3,485	4,770	Coal, stone, petroleum.
Loudoun	3,134	3,590	Stone.
Louisa	W	W	Do.
Lynchburg (City)	-------	W	Do.
Madison	W	W	Do.
Mecklenburg	W	W	Do.
Middlesex	W	W	Sand and gravel.
Montgomery	W	546	Stone, clays, coal.
Nansemond	W	W	Stone, clays, sand and gravel.
Nelson	W	W	Stone, aplite.
New Kent	W	W	Sand and gravel.
Newport News (City)	-------	218	Do.
Northampton	W	W	Do.
Northumberland	7	6	Do.
Nottaway	W	W	Stone.
Orange	W	W	Clays.
Page	W	84	Sand and gravel.
Patrick	W	W	Stone.
Pittsylvania	W	W	Stone, sand and gravel.
Powhatan	W	---------	
Prince Edward	W	W	Kyanite, stone.
Prince George	W	W	Sand and gravel.
Prince William	W	W	Stone, clays.
Pulaski	W	W	Stone, iron ore (pigment material).
Rappahannock	W	W	Stone.
Roanoke	W	W	Stone, clays.
Rockbridge	1,299	1,014	Stone, sand and gravel, clays.
Rockingham	1,417	1,323	Stone, sand and gravel.
Russell	13,422	10,988	Coal, stone, clays.
Scott	1,058	1,287	Stone, coal.
Shenandoah	2,724	W	Lime, stone.
Smyth	W	W	Lime, salt, stone, sand and gravel, clays.
Spotsylvania	W	W	Sand and gravel, stone.
Stafford	W	W	Sand and gravel.
Tazewell[4]	1,140	1,379	Stone, coal, lime, clays.
Virginia Beach (City)	710	991	Sand and gravel.
Warren	W	W	Cement, stone, sand and gravel.
Washington	1,682	1,483	Stone, gypsum.
Westmoreland	W	W	Sand and gravel.
Wise[4]	36,835	39,828	Coal, stone.
Wythe	W	W	Zinc, stone, lead, sand and gravel.
York	W	W	Sand and gravel.
Undistributed[5]	75,080	77,697	
Total[6]	283,685	295,663	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Amelia, Arlington, Charlotte, Cumberland, Greene, James City, King and Queen, King George, Lancaster, Lunenberg, Mathews, Richmond, Southampton, Surry, and Sussex.

[2] Excludes sand and gravel; included with "Undistributed."

[3] Excludes stone and petroleum; included with "Undistributed."

[4] Excludes stone; included with "Undistributed."

[5] Includes sand and gravel that cannot be assigned to specific counties, gem stones, natural gas, and values indicated by symbol W.

[6] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Virginia business activity

	1967	1968 p	Change (percent)
Employment and labor force, annual average:			
Civilian work force ______ thousands__	1,691.6	1,742.7	+3.0
Workers on strike ______ do____	1.2	0.5	—58.3
Unemployment ______ do____	47.8	47.2	—1.3
Total employment ______ do____	1,642.6	1,695.0	+3.2
Agriculture ______ do____	90.2	88.1	—2.3
Nonagriculture ______ do____	1,552.4	1,606.9	+3.5
Manufacturing ______ do____	346.0	362.2	+4.7
Nonmanufacturing ______ do____	984.2	1,019.7	+3.6
Other [1] ______ do____	222.2	225.0	+1.3
Personal income:			
Total ______ millions__	$12,719	$14,008	+10.1
Per capita ______	$2,801	$3,049	+8.9
Construction activity:			
Building permits ______ millions__	$321.9	$429.9	+33.6
Residential construction (total valuation) ______ do____	$399.1	$502.8	+26.0
New housing units authorized ______	36,450	42,218	+15.8
Portland cement shipments to and within Virginia thousand 376-pound barrels__	8,314.0	8,921.3	+7.3
Farm marketing, cash receipts:			
Livestock and products ______ millions__	$272.9	$283.7	+4.0
Crops ______ do____	$239.6	$226.3	—5.6
Government payments ______ do____	$17.6	$17.8	+1.1
Total ______ do____	$530.1	$527.9	—.4
Mineral production ______ do____	$284.0	$295.7	+4.1
Forest resources, total value attributable ______ do____	$656.3	$690.5	+5.2

p Preliminary.

[1] Includes self-employed, unpaid family workers and domestics, and Federal Government workers in the Virginia portion of Washington, D.C., metropolitan area.

Sources: U.S. Department of Commerce; U.S. Department of Agriculture; Federal Reserve Bank of Richmond; U.S. Department of Labor, Virginia Department of Agriculture; Virginia Employment Commission, and Virginia Division of Forestry.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal ______	11,550	196	2,266	17,999	28	869	49.84	11,823
Metal ______	336	267	90	718	______	32	44.58	599
Nonmetal ______	700	263	184	1,474	______	39	26.46	491
Sand and gravel ______	605	239	145	1,358	______	34	25.03	373
Stone ______	3,784	265	1,003	8,331	4	171	21.00	3,998
Total [1] ______	16,975	217	3,687	29,880	32	1,145	39.89	8,291
1968: p								
Coal ______	12,100	195	2,359	18,895	12	856	45.94	6,166
Metal ______	320	263	84	672	______	42	62.48	1,764
Nonmetal ______	630	263	165	1,314	______	31	23.58	778
Sand and gravel ______	555	246	186	1,228	______	17	13.84	370
Stone ______	3,955	265	1,050	8,629	3	201	23.64	2,693
Total [1] ______	17,555	216	3,794	30,739	15	1,147	37.80	4,633

p Preliminary.

[1] Data may not add to totals shown because of independent rounding.

Studies of the geology and mineral resources of Virginia included reports on the ground-water resources of two Virginia counties;[2] the geology of several Virginia quadrangles;[3] a bibliography of the State's geology and mineral resources;[4] and a directory of the mineral industry in Virginia.[5] The last publication, issued annually, lists 256 companies and individuals, exclusive of coal producers, on record as of March 15, 1968. The listing includes portable crushing plants, some captive and intermittent operations, and some processors of out-of-State or imported materials.

Trends and Developments.—During 1968 announcements were made to locate 131 new manufacturing facilities in Virginia and to expand 126 existing facilities according to the State's Division of Industrial Development. About 15,200 new manufacturing jobs are expected to result from the announced new plants and expansions.

While Virginia coal production reached an alltime high of 37 million tons in 1968, coal mining employment declined about 5 percent from the 11,000 workers employed in 1967. Declining mine employment is a long-established trend resulting from the continuing mechanization of coal mines. However, several new mines now under construction in the coal area of southwestern Virginia are expected to help offset the current decline in mine employment when in production. Coal mining is by far the most important section of Virginia's mining industry, accounting for about three-quarters of all mine employment. All mine employment (coal and other commodities) in 1968 was around 13,800 workers.

Plans were announced in 1968 by Virginia Electric and Power County to build a nuclear-fuel power-generating station on the North Anna River in Louisa County. The proposed project, which will be known as the North Anna Power Station, reportedly will have an ultimate capacity of at least 4 million kilowatts. This facility will be the company's second nuclear-fuel power-generating plant; a 1.6-million-kilowatt station is under construction in Surry County on the James River. An 11,000-acre lake to provide cooling water for the proposed facility will be created by damming the North Anna River near Smith's Mill Bridge. The lake will extend into parts of Louisa, Spotsylvania, and Orange Counties. A series of canals and lagoons on adjoining company property will cool the effluent before the water is returned to the lake from which it was initially pumped. Ultimately, development of the project is expected to create a large recreational area. Also in 1968 the company announced it had filed application with the Federal Power Commission to construct a 1-million-kilowatt, pumped-hydroelectric project on the Calfpasture River and Little Mill Creek in Rockbridge, Augusta, and Bath Counties. The project, to be called Marble Valley, is scheduled for operation in early 1975.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Coal, the most important mineral commodity produced in Virginia, accounted for 60.5 percent of the value of the State's mineral production in 1968, compared with 60.3 percent in 1967. Coal production increased in three of the eight coal-producing counties and rose to 37 million short tons valued at $179 million; establishing 1968 as the peak year in both output and value. Mine output was $245,000 short tons, or 0.6 percent greater and output value was $7.8 million or 4.5 percent higher than in 1967, the previous record output and value year. The greater than proportional increase in value was due to an average increase of $0.18 per ton in 1968. Production data include coal produced from deposits within Virginia, whether the mine opening is or is not inside the State boundary, and exclude operations producing less than 1,000 tons per year. Consequently, production data published by the Federal Bureau of Mines may differ somewhat from data published by the State.

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[2] Sinnott, Allen and G. Chase Tibbitts, Jr. Ground-Water Resources of Accomack and Northampton Counties, Virginia. Virginia Div. Miner. Res. (Charlottesville, Va.), Miner. Res. Rept. 9, 1968, 113 pp.

[3] Coch, Nicholas K. Geology of the Benns Church, Smithfield, Windsor, and Chuckatuck Quadrangles, Virginia. Virginia Div. Miner. Res. (Charlottesville, Va.), Rept. of Inv. 17, 1968, 39 pp.

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Spencer, Edgar W. Geology of the Natural Bridge, Sugarloaf Mountain, Buchanan, and Arnold Valley Quadrangles, Virginia. Virginia Div. Miner. Res. (Charlottesville, Va.), Rept. of Inv. 13, 1968, 55 pp.

[4] Hoffer, F. B. Bibliography of Virginia Geology and Mineral Resources, 1941–1949. Virginia Div. Miner. Res. (Charlottesville, Va.), Inf. Circ. 14, 1968, 58 pp.

[5] LeVan, D. C., Directory of the Mineral Industry of Virginia. Virginia Div. Miner. Res. (Charlottesville, Va.), 1968, 43 pp.

Both high- and low-volatile bituminous coals were produced for electric-power generation, industrial and domestic heating, other industrial uses, coke feedstock, and export. A small quantity of semianthracite coal, mined in Montgomery County, was produced for domestic heating. Four of the eight southwestern counties in which coal was mined—Buchanan, Dickenson, Wise, and Russell—accounted for 96 percent of the total output compared with 97 percent in 1967. Buchanan County, where 59 percent of Virginia's active coal mines were located, produced 43 percent of the State's output in 1968.

The State's record-breaking coal production was achieved with 109 fewer mines of all types than in 1967. Underground production comprised 85 percent of the total output, 2 percent more than in 1967. Some 900,000 additional tons of coal were mined underground with 126 fewer mines than the 784 active in 1967. Of the remaining coal output, 11 percent was from strip mines and 4 percent was from auger mines.

Coal was produced by underground mines in all of the eight coal-producing counties and also by strip and auger mines in six counties. In order of output, Buchanan, Dickenson, Wise, and Russell Counties led in underground mine tonnage; Wise, Dickenson, and Buchanan Counties in strip mine output; and Buchanan, Wise and Dickenson Counties in auger mine production. The average value per ton for underground-mined coal was $5.07; for strip-mined coal, $3.55; for auger-mined coal, $3.48; and for the combined output by all three mining methods, $4.84. Principal seams mined included Blair, Bolling, Clintwood, Darby, Eagle, Hagy, Harlan, High Splint, Imboden, Jawbone, Jewell, Kelly, Lyons, Norton, Parsons, Pocahontas No. 3, Red Ash, Splash Dam, Taggart, Tiller, Upper and Lower Banner, Upper and Lower Standiford, and Widow Kennedy.

Of the total underground output, 86 percent was mechanically loaded, 6 percent

Table 5.—Coal (bituminous) production[1] by counties

(Thousand short tons and thousand dollars)

County	1967					1968				
	Number of mines			Total production		Number of mines			Total production	
	Underground	Strip	Auger	Quantity	Value [2]	Underground	Strip	Auger	Quantity	Value [2]
Buchanan	520	23	28	15,529	$70,541	430	21	27	15,804	$77,251
Dickenson	75	13	10	9,579	46,482	58	18	12	9,062	45,479
Lee	43	5	5	835	3,485	34	10	9	1,227	4,770
Montgomery [3]	1	-----	-----	W	W	1	-----	-----	W	W
Russell	26	4	2	2,278	12,695	21	3	2	2,010	10,297
Scott	1	-----	-----	W	W	1	-----	-----	W	W
Tazewell	5	2	1	311	1,044	6	2	1	298	1,268
Wise	113	23	18	8,171	36,835	107	32	14	8,554	39,828
Undistributed	-----	-----	-----	19	100	-----	-----	-----	11	53
Total	784	70	64	[4] 36,721	[4] 171,183	658	86	65	36,966	178,946

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Excludes mines producing less than 1,000 short tons.

[2] Value received or charged for coal, f.o.b. mine, including selling cost. Includes value for coal not sold but used by producer, such as mine fuel and coal coked as estimated by producer at average prices that might have been received if such coal had been sold commercially.

[3] Semianthracite coal; quantity and value included in bituminous coal total.

[4] Data may not add to totals shown because of independent rounding.

higher than in 1967, and 29 percent higher than in 1965. These increases reflected the trend toward modernization and mechanization in the State's underground mines.

A total of 335 mobile loading machines (19 more than in 1967) accounted for 57 percent of the mechanically loaded tonnage; 98 continuous mining machines (four more than in 1967) accounted for 38 percent; long-wall machines and hand-loaded face conveyors accounted for the remainder. Of the total coal mined, 53 percent of the product was mechanically cleaned in 33 plants. Wet washing, other than with jigs, was the principal method of cleaning and accounted for 87 percent of the cleaned coal. Of the cleaned coal, 49 percent was thermally dried. Of the total coal mined, 36 percent was crushed. Fourteen percent of the total coal output was treated with dust-allaying and antifreezing preparations, of which oil predominated (98.5 percent).

Coke.—Coal was converted to coke in beehive and Mitchell type ovens; no by-product recovery was made. In 1968 coke was produced in three plants (three companies), one in Buchanan County and two in Wise County. The State's total coking capacity was substantially lower in 1968 due to three plant shutdowns in Wise County in 1967. Virginia's coking industry is described in detail in a recent publication.[6]

Petroleum and Natural Gas.—Natural gas production data in table 1 are reported to the Bureau of Mines by pipeline companies and are comparable with other State chapter data, although not necessarily with data reported by State agencies. The production of natural gas for commercial use was 3,389 million cubic feet, 11 percent less than that of 1967. The output was delivered to the pipelines of Atlantic Seaboard Corp., Consolidated Gas Supply Corp., and the Kentucky-West Virginia Gas Co. According to the Virginia Department of Labor and Industry, Division of Mines and Quarries, natural gas was produced in four southwestern counties—Tazewell (1,963 million cubic feet), Buchanan (908 million cubic feet), Dickenson (508 million cubic feet), and Wise (10 million cubic feet). At yearend 111 gas wells were operating, compared with 112 in 1967. Reserves of natural gas were 34,341 million cubic feet, as reported by The American Gas Association. This was 3,457 million cubic feet less than reported in 1967. There were no facilities for the underground storage of natural gas in Virginia; however, the Washington Gas Light Co. operated an underground facility in Fairfax County for the storage of liquefied petroleum gases.

During 1968, production of crude petroleum in Virginia, totaled 2,583 barrels compared with 3,491 barrels in 1967. All production was from Lee County, with the Rose Hill field accounting for 1,688 barrels and the Ben Hur field for 895 barrels. At yearend, five oil wells were operating compared with four at the close of 1967.

Oil and gas activity in Virginia during 1968 was described in detail in a recent publication.[7] A coking and catalytic cracking and reforming refinery was operated by the American Oil Co., at Yorktown, York County. Operating capacity was 43,600 barrels per calendar day.

NONMETALS

Aplite.—Output of aplite decreased substantially but the value decline was less severe because of a higher average unit value in 1968. Production of this commodity, chiefly for use in glassmaking, was from two operations, one in Nelson County and one in Hanover County. A limited quantity of the material from a second operation in Nelson County and from an operation in Amherst County was produced for use chiefly as an aggregate.

Cement.—Reversing a declining trend, sales of portland cement increased in 1968. Both shipments and value rose 6 percent. Shipments of masonry cement rose 5 percent, but the value declined 5 percent due to an average decrease of $0.33 per barrel compared with 1967 prices. Of the total cement shipments (portland and masonry), portland cement accounted for 88 percent of shipments and 84 percent of the total value.

Portland cement plant capacity was virtually unchanged during the year. Four plants manufactured cement; two made both portland and masonry cement, one plant made only portland cement, and one plant produced only masonry cement. The wet process of manufacturing portland cement was used by one plant while two plants used the dry process. During 1968, cement was produced in Augusta, Botetourt, and Warren Counties and in the city of Chesapeake; the facility in Augusta County reportedly ceased operations at yearend.

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[6] Sweet, Palmer C. Coking Industry in Virginia. Virginia Minerals (Virginia Div. of Miner. Res., Charlottsville, Va.), v.15, No. 1, February 1969, pp. 1–6.

[7] Young, David M. Oil and Gas Development in Virginia During 1968. Virginia Minerals (Virginia Div. of Miner. Res., Charlottsville, Va.), v. 15, No. 2, May 1969, pp.18–19.

Cement producers mined low magnesian limestone, shale, clay, and calcareous marl for their own use. Ingredients purchased for use in cement manufacture included sand, oystershell, mill scale, gypsum, various air-entraining compounds, and a variety of grinding aids. Over four-fifths of the electrical energy used was purchased commercially.

General use and moderate heat types (Types I and II) comprised the bulk of portland cement produced and marketed; a limited quantity of high-early-strength cement (Type III) was produced and shipped. Both air-entrained and non-air-entrained types were produced; the latter accounted for most of the output. Most of the shipments were in bulk, and by railroad, but sizable shipments were also made by truck. Shipments of cement in containers (94-pound paper bags) were sizable and were made by railroad and truck.

Distribution of portland cement for the various consumer uses in 1968 was as follows: 58 percent to ready-mixed concrete companies (58 percent in 1967); 18 percent to concrete products manufacturers (18 percent in 1967); 11 percent to contractors, including highway contractors (13 percent in 1967); and 13 percent to other users, including building material dealers, Federal, State, and local government agencies, and miscellaneous customers (11 percent in 1967).

Seventy percent of portland cement shipments terminated within the State; the remainder, in order of decreasing shipments, went to North Carolina, West Virginia, South Carolina, and Maryland. Masonry cement shipments went to 31 States, chiefly Virginia, North Carolina, Maryland, South Carolina, and District of Columbia; 62 percent of the shipments terminated in Virginia.

Clays.—Sharing in the relatively mild increase in building activity, both output and value of clay rose 6 percent. Sixty-seven percent of the clay and shale output was consumed in brick manufacture, compared with 68 percent in 1967. The principal uses for the balance of clay and shale were as lightweight aggregate and in the manufacture of portland cement. Some was also consumed in the making of vitrified sewer pipe, flue linings, pottery, clay dummies (shot-hole tampers), and other clay products.

Clay production was reported from 21 pits in 15 counties. In order of output the chief producing counties were Botetourt, Russell, Chesterfield, Orange, and Nansemond; in order of output value they were Orange, Botetourt, Prince William, Nansemond, and Chesterfield. Five counties produced nearly two-thirds of the State output and five accounted for three-quarters of the value.

Table 6.—Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	1,440	$1,614
1965	1,415	1,657
1966	1,486	1,813
1967	1,382	1,623
1968	1,462	1,714

Feldspar.—Output was greater than in 1967, but the total value declined moderately due to a lower average market value. One company produced feldspar from two mines in Bedford County. Mixed feldspar (soda and potash) was mined near the company's processing and grinding mill in Bedford. The mill output was used chiefly for pottery and ceramic enamel manufacture.

Gem Stones.—Mineral collectors and hobbyists collected a variety of semiprecious gems and mineral specimens in various areas in Virginia.

Gypsum.—Output and value for crude gypsum rose 4 percent. The raw gypsum mined at Plasterco, Washington County, was calcined or otherwise processed and manufactured into plasterboard and other gypsum products by United States Gypsum Co. at its Plasterco plant. The company also processed imported gypsum at a plant in Norfolk for use in their products.

Kyanite.—While output of the crude ore and of the derived refined kyanite declined moderately, average value of the processed material increased moderately. Shipments were primarily to manufacturers of refractories and other ceramic products. Two mines and three processing plants were operated by one company in adjacent Buckingham and Prince Edward Counties. The company also operated a grinding and bagging plant in the latter county.

Only a small part of the beneficiated kyanite (Al_2SiO_5) is used in the raw state; the bulk of production is calcined to mullite, one of the most important refractory materials used in the ceramic industry. Quartz sand, recovered during the processing of kyanite, was marketed by a subsidiary organization for industrial and construction applications. Virginia is North America's leading producer of kyanite.

Lime.—Alltime highs in production and value of lime were set in 1968; lime output and value were 11 and 8 percent greater, respectively, than in 1967, and exceeded the previous 1965 record year by 8 percent in output and 5 percent in value. Largely responsible for the gain in output was the increasing demand for industrial lime by the chemical and allied industries, and in metallurgy, especially the rapidly growing basic oxygen steelmaking process. Compared with 1967 levels, the shipments were greater for all reported uses of lime. The output value decreased moderately for agricultural lime, but increased moderately for building and industrial lime notwithstanding lower average unit values for all uses in 1968. All but 4 percent of the lime sold or used, including both quicklime and hydrated lime, was consumed in chemical, metallurgical, or other industrial uses.

Primary lime production was reported by 10 companies from six counties and one independent city. Maintaining this order since 1962, Giles, Smyth, and Shenandoah Counties were the chief producing areas, in order of output and value, and accounted for 85 percent of the State's 1968 lime output.

Processing equipment used in limemaking included pot, shaft, and rotary kilns and batch and continuous hydrators. Raw materials included high-calcium limestone (predominately), dolomitic limestone, and oystershell. Approximately 1.8 million tons of limestone were calcined to produce the total lime output. Fuels included bituminous coal, coke, and natural gas.

Virtually the entire output was high-calcium lime of which 93 percent was used or marketed as quicklime and the remainder as the hydrated product. Uses for lime were in the manufacture of alkalies, calcium carbide, and paper; as a flux in steelmaking and electrometallurgical operations; in sewage and trade-wastes treatment; in the purification and treatment of water; for agricultural purposes and leather tanning; for construction; and in miscellaneous applications. Of the State's output, 36 percent was sold or used within Virginia and the remainder was shipped principally to Pennsylvania, Kentucky, Ohio, West Virginia, North Carolina, Maryland, South Carolina, Wisconsin, and Georgia.

Nitrogen Compounds.—Allied Chemical Corp., Nitrogen Division, Hopewell, Prince George County, produced nitrogen compounds such as ammonia, urea, and ammonium sulfate for use chiefly as fertilizer or fertilizer ingredients.

Salt.—Chlorine, caustic soda, soda ash, and other chemicals were produced by

Table 7.—Lime sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Year	Agricultural		Building		Chemical and other industrial		Total[1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1964	W	W	W	W	742	$9,251	780	$9,781
1965	W	W	W	W	809	10,080	847	10,584
1966	26	$343	10	$142	805	10,001	840	10,486
1967	28	324	8	118	793	9,903	829	10,345
1968	31	306	10	129	878	10,704	919	11,138

W Withheld to avoid disclosing individual company confidential data; included with "Total."
[1] Data may not add to totals shown because of independent rounding.

Olin-Mathieson Chemical Corp., Saltville, Smyth County, using brine recovered from nearby captive salt wells. Production of salt was moderately higher than in 1967.

Sand and Gravel.—Mildly heightened building activity in Virginia in 1968 increased the demand for sand and gravel as construction aggregates; sand and gravel rose 10 percent in output and 9 percent in value. Commercial output comprised over 99 percent of total production and value; the remainder was State and local government output, mainly for use in highway maintenance. Of the commercial production 85 percent was used as coarse and fine construction aggregates in building (40 percent) and paving (45 percent).

Sand comprised 60 percent of the commercial sand and gravel output and 51 percent of the total commercial value. While less than one-tenth of the sand output was marketed as special industrial silica sands used for glassmaking, engine sand, filler, and other nonconstruction uses, almost two-tenths of the value of sand output was attributed to these uses.

Eighty-six percent of the total commercial sand and gravel output was screened, washed, or otherwise processed. Eighty-five commercial sand and gravel operations were active in 1968, compared with 78 in the previous year. Of these 85 operations, 58 processed their output at 40 stationary, 15 portable, and three dredging installations. The remaining 27 operations recovered unprocessed or bank-run material. Fifty-seven percent of the commercial tonnage was shipped by truck and most of the remainder by rail or water; a small quantity was used captively or transported by unspecified methods.

Production of sand and gravel from all operations was reported from 38 counties and one independent city. In order of output the principal sand-and-gravel producing areas were Henrico and Fairfax Counties, the independent city of Virginia Beach, and Chesterfield, Prince George, and Charles Counties. Over three-quarters of both the total output and value were contributed by these six producing areas.

Forty-one of the 85 commercial sand and gravel operations had an annual output range of up to 50,000 tons and accounted for 7.4 percent of the total commercial output, 39 had an output range of from 50,000 to 500,000 tons and accounted for 57.2 percent, four had an output range of from 500,000 to 1 million tons and accounted for 24.2 percent, and one had an output range of over 1 million tons and accounted for 11.2 percent. The bulk of sand and gravel recovery was by dredging and open-pit mining; a sizable tonnage of industrial silica sand was produced from crushed sandstone and quartzite, and a limited amount was obtained in the processing of kyanite.

Soapstone.—Crushed and ground soapstone was produced by Blue Ridge Talc Co., Inc., near Henry, principally for use in insecticides and foundry facings. Output and value increased moderately. Soapstone used as a dimension stone is included with miscellaneous stone in the Stone section of this chapter.

Stone.—Ranking next to coal in importance to the mineral economy of Virginia, stone accounted for 18 percent of the State's total value of mineral production in 1968. Total stone output declined slightly, but value rose 2 percent from that in 1967. Substantially higher prices received for dimension stone (principally soapstone) and a slight increase in the average unit value of crushed stone were responsible for the rise in total stone value.

Varied types of stone were mined or quarried in the State; in order of output value they were limestone (including dolomite), granite, traprock (basalt and diabase), miscellaneous stone (including amphibolite, schist, soapstone, and "Virginia Greenstone"), slate, sandstone (including quartzite and quartz), calcareous marl, and marble. Both crushed or broken stone and dimension stone were produced. Marine shell (oystershell) for use as aglime, was produced in limited quantity as a coproduct of oyster processing.

Crushed stone was produced from all the stone varieties and comprised virtually all of the total stone output (99.8 percent) and the major share of the total value (90.6 percent). Of the total crushed stone output, 73 percent or 22.9 million tons was used for building purposes (concrete aggregate and roadstone) the same percentage and tonnage as in 1967. In addition, 13 percent was used in cement and lime manufacture (limestone and calcareous marl), 4 percent was used as agricultural dressing (limestone, dolomite, and calcareous marl), 1 percent was used as fluxstone (limestone),

Table 8.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,332	$2,757	2,552	$3,006
Paving	2,233	1,862	2,948	2,348
Fill	634	305	357	215
Other [1]	492	1,257	621	1,321
Total	5,691	6,181	6,478	6,890
Gravel:				
Building	1,433	2,739	1,806	3,152
Paving	2,307	3,157	1,934	2,769
Other [2]	203	179	556	802
Total	3,943	6,075	4,296	6,723
Total sand and gravel	9,634	12,256	10,774	13,613
Government-and-contractor operations:				
Sand:				
Paving	27	10	26	9
Fill	34	13	41	14
Total	61	23	67	23
Gravel:				
Paving	162	204	18	8
Fill	6	11	--------	--------
Total	168	215	18	8
Total sand and gravel	229	238	85	31
All operations:				
Sand	5,752	6,204	6,545	6,913
Gravel	4,111	6,290	4,314	6,731
Total	9,863	12,494	10,859	13,644

[1] Includes railroad ballast (1968), glass, engine, ground sand, and sand for other construction and industrial uses.

[2] Includes fill and gravel for miscellaneous and other uses.

and the remainder as railroad ballast, riprap, stone sand, and for miscellaneous and unspecified applications. Crushed stone declined slightly in output and gained slightly in value, compared with 1967 levels. Despite a 2-percent decline in limestone and dolomite output, value increased 2 percent in 1968. Increases in output and value were reported for traprock (basalt and diabase), granite, and miscellaneous stone; decreases were reported for calcareous marl, marble, sandstone, and slate.

In addition, dimension products, in order of value, were produced from miscellaneous stone, slate, traprock (diabase), sandstone, and limestone. Miscellaneous stone gained only 3 percent in quantity, but jumped 23 percent in value mainly due to higher prices received for soapstone dimension products in 1968. Laboratory and architectural stone and flagging were the principal products derived from the soapstone, the most important miscellaneous stone type. Other miscellaneous stone produced for dimension uses included "Virginia Greenstone", amphibolite, and schist. Slate declined moderately in both quantity of output and value; lower prices for fabricated slate products were reflected in a greater than proportional value decline. The dimension slate found application as roofing and flooring material and for structural and sanitary use, and wall facing. Limited quantities of traprock, sandstone (including quartzite), and limestone were also produced in 1968. While a low-output commodity in terms of tonnage, dimension stone accounted for 9.4 percent of the total stone output value.

Commercial stone production including marine shell was reported from 54 counties and two independent cities. In terms of ton-

Table 9.—Stone sold or used by producers, by kinds and uses

(Thousand short tons and thousand dollars)

Kind and use	1967		1968	
	Quantity	Value	Quantity	Value
Dimension stone:				
Sandstone, quartz and quartzite: All uses	1	$21	W	W
Undistributed [1]	69	4,616	69	$5,011
Total [2]	71	4,637	69	5,011
Crushed and broken stone:				
Traprock (basalt, diabase): Aggregates [3]	3,534	5,817	3,586	6,207
Granite:				
Aggregates [4]	8,680	13,847	9,126	14,182
Riprap [5]	266	471	251	372
Limestone and dolomite:				
Fluxing stone	805	1,820	W	W
Aggregates [4]	10,094	13,447	9,702	13,517
Railroad ballast	268	309	381	426
Agricultural	1,132	2,045	1,196	2,160
Riprap	11	12	14	18
Miscellaneous	4,586	7,660	5,286	9,098
Sandstone, quartz and quartzite:				
Aggregates [4]	593	867	497	723
Miscellaneous [6]	80	214	68	162
Undistributed [7]	1,206	1,825	1,041	1,656
Total [2]	31,254	47,833	31,148	48,522
Grand total [2]	31,324	52,470	31,217	53,533

W Withheld to avoid disclosing individual company confidential data.

[1] Includes limestone (1968), sandstone, quartz and quartzite (1968), traprock (diabase), slate, and miscellaneous stone.

[2] Data may not add to totals because of independent rounding.

[3] Includes stone sand (1967), riprap, dense graded road base stone, and concrete, bituminous, macadam and surface treatment aggregates, and other uses (1968).

[4] Includes dense graded road base stone, and concrete, bituminous, macadam, and surface treatment aggregates.

[5] Includes railroad ballast and other uses (1968).

[6] Includes riprap (1968), railroad ballast, flux (1968), stone sand (1968), and other uses.

[7] Includes miscellaneous stone, calcareous marl, marble, shell, and slate.

nage, the principal stone-producing counties were Botetourt (crushed limestone), Goochland (crushed granite), Loudoun (crushed diabase), Augusta (crushed limestone and quartzite), and Frederick (crushed limestone). In terms of product value, the most important counties were Loudoun (crushed diabase), Botetourt (crushed limestone), Giles (crushed limestone), Nelson (dimension and crushed miscellaneous stone), and Buckingham (dimension slate and crushed slate and quartzite). Thirty-one percent of the total stone quantity was contributed by five counties, and five counties accounted for 30 percent of the output value.

In 1968, production of limestone (including dolomite) was reported from 26 counties, granite from 17, basalt (including diabase) from seven, miscellaneous stone from two, slate from one, sandstone (including quartz and quartzite) from 13, calcareous marl from two, and marble from one. In addition, production of miscellaneous stone was reported from one independent city, and one independent city reported production of oystershell. The number of counties listed exceeds the number of counties in which all types of stone was produced because of duplication of counties when considering each variety produced.

Eleven counties produced more than 1 million tons of stone each, and 19 counties had output valued in excess of $1 million each. Crushed stone was produced in all the counties reporting stone output. Dimension stone was produced in five counties and in one independent city. Commercial production of stone accounted for over 99 percent of total stone output and value.

Sulfur.—Hydrogen sulfide, recovered from fuel gas, was converted to elemental sulfur by the American Oil Co. at its Yorktown refinery. Shipments decreased substantially, but value of shipments only moderately due to a higher average unit value in 1968.

METALS

Iron Ore (Pigment Material).—Natural iron-oxide pigments were produced by one firm at Hiwassee, Pulaski County, from local deposits of earthy forms of hydrous and anhydrous iron oxides including ocher, sienna, and umber. Manufactured iron oxides, also for use in pigment manufacture and for other purposes, were produced at the company's Pulaski facilities. Natural iron-oxide pigments were also produced by a firm at Henry, Henry County, from hematite obtained out of State. The finished iron-oxide pigments are used in fertilizers, as foundry facings, in cement, printing inks, and paint manufacture, and in other products. Total marketed output of both natural and manufactured finished iron-oxide pigments was substantially less than in 1967.

Lead and Zinc.—Output of crude zinc-lead ore, limited to two mines in Wythe County operated by one company, was slightly greater than in 1967. The ratio of zinc recovery to that of lead was about 5.39 to 1. In 1968 lead output was 4 percent greater but the value declined slightly. Zinc output and value rose 2 percent.

Table 10.—Mine production of recoverable lead and zinc

Year	Lead		Zinc	
	Short tons	Value (thousands)	Short tons	Value [1] (thousands)
1964	3,857	$1,011	21,004	$5,700
1965	3,651	1,139	20,491	5,942
1966	3,078	930	17,666	5,123
1967	3,430	960	18,846	5,088
1968	3,573	944	19,257	5,199

[1] Recoverable zinc valued at the yearly average price of prime western-slab zinc, East St. Louis market. Value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

Titanium Concentrates.—Marketed production of titanium concentrates (ilmenite and rutile) decreased. Ilmenite, which comprised the bulk of marketed production, declined moderately in output and slightly in value; rutile dropped sharply in both output and value. Both ilmenite ($FeTiO_3$) and rutile (TiO_2) are used in the manufacture of titanium dioxide pigments. Rutile also is used as welding rod coating. Ilmenite was produced by one firm in Amherst County, and both ilmenite and rutile were produced by another firm in Hanover County. The latter company discontinued production of titanium minerals in August 1968.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Aplite (crude): International Minerals & Chemical Corp., Industrial Minerals Div.	Piney River, Va. 22964	Quarry	Nelson.
Cement:			
Lehigh Portland Cement Co.[1]	718 Hamilton St. Allentown, Pa. 18101	Pit, quarry, and plant.	Augusta.
Lone Star Cement Corp.[2]	3315 W. Broad St. Richmond, Va. 23230	do	Botetourt.
Lone Star Cement Corp.[3]		Plant	Chesapeake (City).
Riverton Lime & Stone Co., Inc.[4]	Riverton, Va. 22651	Quarry and plant.	Warren.
Clays (miscellaneous and shale):			
Brick and Tile Corp	P.O. Box 45 Lawrenceville, Va. 23868	Pit	Brunswick.
General Shale Products Corp	Box 3547 Johnson City, Tenn. 37601	Pit	Chesterfield.
Lightweight Aggregate Div. Clinchfield Coal Company [5]	Dante, Va. 24237	Plant	Russell.
Locher Brick Co., Inc	Glasgow, Va. 24555	Pit	Rockbridge.
Redford Brick Co., Inc	Box 4096 Richmond, Va. 23224	Pit	Chesterfield.
Weblite Corp	Box 780 Roanoke, Va. 23204	Pit	Botetourt.
Webster Brick Co., Inc		Pit Pit Pit	Do. Nansemond. Orange.
Woodbridge Clay Products Co.	Rt. 3, Box 240 Manassas, Va. 22110	Pit	Prince William.

See footnotes at end of table.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal (bituminous):			
Betty B. Coal Co.	Clintwood, Va. 24228	Underground mine.	Dickenson.
Clinchfield Coal Co.	Dante, Va. 24237	do	Buchanan.
Clinchfield Coal Co.[6]		do	Dickenson.
Clinchfield Coal Co.[7]		do	Russell.
Coal Processing Corp	Box 497 Norton, Va. 24273	do	Wise.
Harman Mining Corp	Harman, Va. 24618	do	Buchanan.
Island Creek Coal Co.[8]	Box 113, Keen Mountain, Va. 24624	do	Do.
Westmoreland Coal Co.[9]	P.O. Box 229 Big Stone Gap, Va. 24219	do	Wise.
Big Six Corp	Box 430 Clintwood, Va. 24228	Strip mine	Dickenson.
Contracting Enterprises	Clintwood, Va. 24228	do	Do.
Stallard Womack Mining Corp.	P.O. Box 389 Appalachia, Va. 24216	do	Do.
Flat Gap Mining Co	Box 387 Norton, Va. 24273	Auger mine	Wise.
Sun Trucking Co	Hazard, Ky. 41701	do	Do.
Coke:			
Christie Coal and Coke Co., Inc.	P.O. Box 409 Norton, Va. 24273	Plant	Do.
Jewell Smokeless Coal Corp	Jewell Valley, Va. 24623	do	Buchanan.
Westmoreland Coal Co., Stonega Div.	Box 229 Big Stone Gap, Va. 24219	do	Wise.
Feldspar (crude): Clinchfield Sand & Feldspar Co., Div. of Harry T. Campbell Sons' Corp.	Campbell Bldg. Towson, Baltimore, Md. 21204	Mines	Bedford.
Gypsum:			
United States Gypsum Co.[10]	101 S. Wacker Drive Chicago, Ill. 60606	Plant	Chesapeake (City).
United States Gypsum Co.[11]		Mine	Smyth.
United States Gypsum Co		Mine and plant	Washington.
Iron-oxide pigments (crude): Imperial Color & Chemical Dept., Hercules, Inc. [12]	Hiwassee, Va. 24347	do	Pulaski.
Iron-oxide pigments (finished): Blue Ridge Talc Co., Inc.	P.O. Box 8 Henry, Va. 24102	Plant	Henry.
Kyanite: Kyanite Mining Corp.[13]	Dillwyn, Va. 23936	Mine and plants	Buckingham and Prince Edward.
Lime:			
Battery Park Fish & Oyster Co.[14]	Battery Park, Va. 23304	Plant	Isle of Wight.
Blue Grass Lime Co.[15]	Rt. 2, Tazewell, Va. 24651	Quarry and plant.	Tazewell.
Chemstone Corporation [15]	Menlo Park Edison, N.J. 08817	do	Shenandoah.
Foote Mineral Co.[15]	Rt. 100, Exton, Pa. 19341	do	Giles.
W. S. Frey Co., Inc.[15]	257 E. Market St. York, Pa. 18701	do	Frederick.
M. J. Grove Lime Co., Div. of The Flintkote Co.[15]	Lime Kiln, Md. 21763	do	Do.
National Gypsum Co.[15]	325 Delaware Ave. Buffalo, N.Y. 14202	do	Giles.
Peery Lime Co.[15]	Box 5 N. Tazewell, Va. 24651	do	Tazewell.
Reliance Fertilizer & Lime Corp.[16]	P.O. Box 4596 Norfolk, Va. 23623	Plant	Chesapeake (City).
Natural gas:			
Ashland Oil and Refining Co	Box 67, Vansant, Va. 24656	Gas wells	Buchanan.
Cabot Corp	P.O. Box 1473 Charleston, W. Va. 25325	Gas well	Do.
Clinchfield Coal Co., Div. of Pittston Co.	Dante, Va. 24237	Gas wells	Dickenson.
Consol-Ray Corp	Pocahontas, Va. 24635	do	Tazewell.
P and S Oil and Gas Corp	305 Nelson Bldg. Charleston, W. Va. 25301	do	Buchanan.
United Fuel Gas Co	P.O. Box 1273 Charleston, W. Va. 25325	do	Buchanan and Tazewell.
Petroleum:			
Trans State Oil Ltd	Ewing, Va. 24248	Oil wells	Lee.
Frank and Grover Neal		do	Lee.
Wilshire Oil Co. of Texas	300 Filmore Street Denver, Colo. 80206	Oil well	Lee.
Petroleum refineries: American Oil Company.[17]	910 S. Michigan Ave. Chicago, Ill. 60605	Plant	York.
Salt: Olin-Mathieson Chemical Corp.[18]	120 Long Ridge Rd. Stamford, Conn. 06902	Brine wells	Smyth.

See footnotes at end of table.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
Commonwealth Sand & Gravel Corp.	P.O. Box 7598 Richmond, Va. 23231	Pit	Henrico.
George F. Dodd Gravel Corp	P.O. Box 4146 Alexandria, Va. 22303	Pit	Fairfax.
Fredericksburg Sand & Gravel Co., Inc.	Rt. 4, Box 57 Fredericksburg, Va. 22401	Pit	Stafford.
Friend Sand & Gravel Co., Inc	209 River St. Petersburg. Va. 23803	Pit	Prince George.
Hilltop Sand & Gravel Co., Inc.	7950 Telegraph Rd. Alexandria, Va. 22310	Pit	Fairfax.
Locher Silica Corp.[19]	Glasgow, Va. 24555	Quarry	Rockbridge.
Massaponax Sand & Gravel	P.O. Box 270 Fredericksburg, Va. 22401	Pit	Spotsylvania.
Sadler Sand & Gravel Corp	P.O. Box 5417 Virginia Beach, Va. 23455	Pit	Henrico.
Southern Materials Co., Inc.[20]	2125 Kimball Terrace Norfolk, Va. 23504	Pit	Chesterfield.
Southern Materials Co., Inc		Dredge Pit	Henrico. Prince George.
Virginia Glass Sand Corp.[19]	P.O. Box 445 Winchester, Va. 22601	Quarry	Frederick.
Virginia Sand & Gravel Co., Inc.	P.O. Box 666 Springfield, Va. 24050	Pit	Fairfax.
West Sand & Gravel Co., Inc	P.O. Box 6008 Richmond, Va. 23222	Pit	Henrico.
E. V. Williams Co., Inc	P.O. Box 938 Norfolk, Va. 23601	Pit	Virginia Beach (City).
Soapstone (talc): Blue Ridge Talc Co., Inc.[21]	P.O. Box 8 Henry, Va. 24102	Quarry	Franklin.
Stone:			
Traprock (diabase)—dimension:			
Buena Black Granite Corp	Box 74, Rapidan, Va. 22733	do	Culpeper.
Virginia Granite Co	P.O. Box 250 Elberton, Va. 23846	do	Do.
Traprock (diabase)—crushed:			
Arlington Stone Co	2633 Shirlington Rd. Arlington, Va. 22206	do	Loudoun.
Bull Run Stone Co., Inc	Box 469 Manassas, Va. 22110	do	Do.
Chantilly Crushed Stone, Inc.	Box 112 Chantilly, Va. 22021	do	Do.
Fairfax Quarries, Inc	Box 7155 Richmond, Va. 23221	do	Fairfax.
Loudoun Quarries, Inc	Box 110 Chantilly, Va. 22021	do	Loudoun.
Sanders Quarry, Inc	335 Waterloo St. Warrenton, Va. 22816	do	Fauquier.
Virginia Trap Rock, Inc	Box 705 Leesburg, Va. 22075	do	Loudoun.
Vulcan Materials Co	P.O. Box 7506 Winston-Salem, N.C. 27109	do	Prince William.
Traprock (basalt)—crushed: Charlottesville Stone Corp.	Box 7155 Richmond, Va. 23221	do	Albemarle.
Granite—crushed:			
Boscobel Granite Corp		do	Goochland.
Burkeville Stone Corp		do	Nottoway.
The General Crushed Stone Co.	712 Drake Bldg. Easton, Pa. 18042	do	Hanover.
Martinsville Stone Corp	Rt. 2, Box 31 Martinsville, Va. 24112	do	Henry.
Rockville Stone Co	Box 7155 Richmond, Va. 23221	do	Goochland.
Salem Stone Corp	P.O. Box 1371 Roanoke, Va. 24007	do	Richland.
Southern Materials Co., Inc.	2125 Kimball Terrace Norfolk, Va. 23504	do	Brunswick and Dinwiddie.
Superior Stone Co., Div. Martin Marietta Corp.	Box 2568 Raleigh, N.C. 27202	do	Albemarle.
Tidewater Crushed Stone & Asphalt Co., Inc.	Deepwater Terminal Rd. Richmond, Va. 23234	do	Chesterfield.
Trego Stone Corp	P.O. Box 2459 Roanoke, Va. 24010	do	Greensville.
Vulcan Materials Co	P.O. Box 7506 Winston-Salem, N.C. 27109	do	Brunswick, Fairfax, Goochland, Halifax, Pittsylvania.

See footnotes at end of table.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone—crushed:			
Blue Ridge Stone Corp	Box 2459 Roanoke, Va. 24010	Quarry	Botetourt and Campbell.
Chemstone Corp., Subsidiary of Engelhard Minerals & Chemicals Corp.	Menlo Park Edison, N.J. 08817	do	Shenandoah.
Foote Minerals Co	Rt. 100, Exton, Pa. 19341	Underground mine.	Giles.
W. S. Frey Co., Inc	257 E. Market St. York, Pa. 18701	Underground and open quarry.	Frederick.
M. J. Grove Lime Co., Div. of The Flintkote Co.	Lime Kiln, Md. 21763	Quarry	Do.
James River Hydrate & Supply Co.	Buchanan, Va. 24066	do	Botetourt.
Liberty Limestone Corp	Buchanan, Va. 24066	do	Botetourt.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	Underground mine.	Giles.
Penn Dixie Cement Corp	P.O. Box 152 Nazareth, Pa. 18064	Quarry	Scott.
Pounding Mill Quarry Corp.	Box 2459 Roanoke, Va. 24010	do	Tazewell.
Rockydale Stone Service Corp.	Rt. 8, Box 635 Roanoke, Va. 24014	do	Campbell.
Rockydale Quarries Corp	----	do	Roanoke.
Vulcan Materials Co	Box 7 Knoxville, Tenn. 37901	do	Washington.
Marble—crushed: Jamison Black Marble Co.	P.O. Box 1198 Roanoke, Va. 24006	do	Rockingham.
Calcareous marl: J. C. Digges & Sons.	White Post, Va. 22663	Pit	Clarke.
Miscellaneous stone—dimension:			
Alberene Stone, Div. of the Georgia Marble Co.[22]	Schuyler, Va. 22969	Quarry	Nelson.
Virginia Greenstone Co., Inc.	Box 897 Lynchburg, Va. 24505	do	Lynchburg (City).
Wade and Griffith	Rt. 1, Floyd, Va. 24091	do	Patrick.
Miscellaneous stone—crushed: Dominion Stone Plant, Inc.	Piney River, Va. 22964	do	Nelson.
Oystershell: Radcliff Materials, Inc.[23]	P.O. Box 816 Norfolk, Va. 23601	Plant	Norfolk.
Quartz and quartzite—crushed:			
H. D. Crowder & Sons	Rt. 1, Austinville, Va. 24312	Quarry	Carroll.
Eastside Quarry	Rt. 1 Waynesboro, Va. 22980	do	Augusta.
The Economy Cast Stone Co.[24]	P.O. Box 3-P Richmond, Va. 23207	do	Albemarle.
Lone Jack Limestone Co., Inc.	P.O. Box 752 Lynchburg, Va. 24505	do	Rockbridge.
Stone & Mineral Corp.[24]	57 Culpeper St. Warrenton, Va. 22186	do	Buckingham and Fluvanna.
Quartzite—dimension:			
J. W. Costello	Box 51, Route 1 Haymarket, Va. 22069	do	Fauquier.
Lofton Lambert	The Plains, Va. 22171	do	Do.
Sandstone—crushed:			
Culpeper Stone Co., Inc	Box 650 Culpeper, Va. 22701	do	Culpeper.
Ironto Sand Corp	P.O. Box 397 Christiansburg, Va. 24073	do	Montgomery.
Newman Brothers Quarry, Inc.	Rt. 3, Hillsville, Va. 24343	do	Wythe.
Sayers Sand Co	Rt. 1, Marion, Va. 24354	do	Smyth.
Sandstone—dimension: B. M. Brosius	Box 853 Warrenton, Va. 22186	do	Fauquier.
Slate—crushed or broken:			
Blue Ridge Slate Corp.[25]	P.O. Box 320 Charlottesville, Va. 22902	Plant	Buckingham.
Solite Corp.[26]	Box 9138 Richmond, Va. 23227	do	Do.
Slate—dimension:			
Arvonia-Buckingham Slate Co., Inc.[27]	Arvonia, Va. 23004	Quarry	Do.
Le Sueur-Richmond Slate Corp.[27]	----	do	Do.
Titanium concentrate:			
American Cyanamid Co.[28]	Wayne, N.J. 07470	Mine and plant	Amherst.
M & T Chemicals, Inc.[29]	P.O. Box 23, Rt. 1 Montpelier, Va. 23192	do	Hanover.
Zinc: The New Jersey Zinc Co.[30]	160 Front St. New York, N.Y. 10038	Underground mine and plant.	Wythe.

See footnotes on page 17.

FOOTNOTES TO TABLE 11

[1] Portland and masonry cement—also captive production of limestone and shale—cement production terminated at yearend.
[2] Portland and masonry cement—also captive production of limestone and shale.
[3] Portland and masonry cement—also captive production of marl and clay in Nansemond County.
[4] Masonry cement only—also produce limestone.
[5] Shale obtained from coal preparation plant as a coproduct.
[6] 9 mines.
[7] 2 mines—shale obtained from coal preparation plant as a coproduct.
[8] 2 mines—some production is captive.
[9] 11 mines.
[10] Process imported gypsum.
[11] Inactive in 1968.
[12] Also finished iron oxide pigments.
[13] Coproduct: quartz sand.
[14] Calcine oystershell.
[15] Calcine limestone.
[16] Calcine oystershell and dolomite.
[17] Coproducts: sulfur and coke.
[18] Various chemicals manufactured from salt and lime at plant—captive limestone converted to lime for use in chemical manufacturing.
[19] Mainly industrial silica (crushed sandstone).
[20] Also produced crushed granite.
[21] Also process out-of-State hematite at plant for pigment manufacture.
[22] Stone variety is soapstone.
[23] No production—shipped from stockpiles—dredging operation terminated in 1967.
[24] Vein quartz.
[25] Roofing granules.
[26] Lightweight aggregate.
[27] Also crushed slate produced.
[28] Ilmenite (pigment material).
[29] Ilmenite and rutile (pigment materials); also produce aplite. Production of titanium minerals discontinued in August 1968.
[30] Coproducts: lead and limestone (dolomitic).

The Mineral Industry of Washington

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Washington Division of Mines and Geology for collecting information on all minerals except fuels.

By William N. Hale,[1] Mary Anne McComb,[2] and Paul McIlroy[3]

Washington's mineral production was valued at $81.4 million in 1968, a decrease of less than 1 percent compared with the 1967 total, but a decrease of 8.6 percent when compared with the 1966 record value of production ($89.1 million). Increases in silver, lead, and sand and gravel were offset by decreases in gold, zinc, and stone. The large gain in silver value was caused primarily by the rise in its selling price and partially by an increase in output. Fifty-five percent of total mineral value was attributed to sand and gravel and stone.

About a quarter of all aluminum produced in the United States came from

Table 1.—Mineral production in Washington[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite .... short tons	100	$1	--------	--------
Cement:				
Portland .... thousand 376-pound barrels	5,614	20,581	6,328	$23,030
Masonry .... thousand 280-pound barrels	65	200	56	175
Clays[2] .... thousand short tons	139	203	140	213
Coal (bituminous) .... do	59	517	178	823
Copper (recoverable content of ores, etc.) .... short tons	21	16	22	18
Gem stones	NA	75	NA	100
Lead (recoverable content of ores, etc.) .... short tons	2,762	773	5,655	1,494
Peat .... do	40,608	181	40,440	159
Sand and gravel .... thousand short tons	28,164	27,520	31,432	27,839
Stone .... do	14,454	19,099	14,331	16,690
Talc and soapstone .... short tons	4,916	26	W	W
Zinc (recoverable content of ores, etc.) .... do	21,540	5,964	13,884	3,749
Value of items that cannot be disclosed: Carbon dioxide (1967), fire clay, diatomite, gold, gypsum, lime, magnesite, mercury (1968), olivine, pumice, silver, tungsten (1967), and values indicated by symbol W	XX	6,911	XX	7,095
Total	XX	82,067	XX	81,385
Total 1957–59 constant dollars	XX	[r] 77,365	XX	[p] 75,710

[p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers.)

[2] Excludes fire clay; included with "Value of items that cannot be disclosed."

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[1] Geologist, Bureau of Mines, Albany, Oreg.

[2] Economist, Bureau of Mines, Albany, Oreg.

[3] Mining engineer, Bureau of Mines, Albany, Oreg.

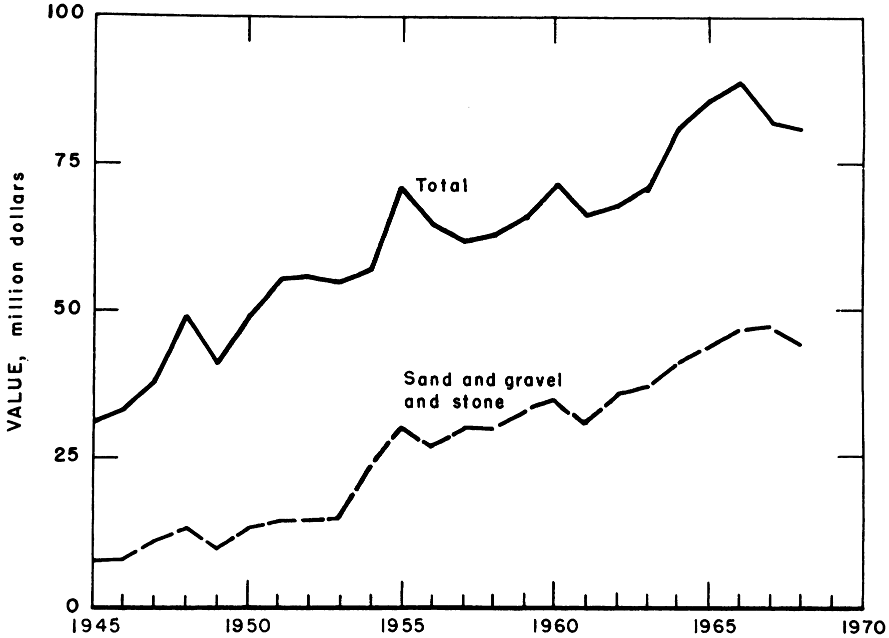

Figure 1.—Value of sand and gravel and stone, and total value of mineral production in Washington.

Washington plants. Bureau of Mines figures showed total U.S. aluminum production to have declined slightly in 1968. Washington's production increased 3.9 percent; thus the State's percentage of total output rose from 23 percent in 1967 to 24 percent. Alumina, an intermediate product in the production of aluminum, was shipped into the State for final processing.

A report which showed the relationship of transportation development and economic growth was released. The report was based on Washington and Oregon as representing the Pacific Northwest.[4]

Construction Trends.—Washington reflected the Nation's increased demand for residential construction in the early spring and summer months. During the latter part of the year, there was a constant decline in new projects. Construction employment increased 3.6 percent over 1967 levels.

Economic Activity and Employment.—The State's personal income rose 10.8 percent, highest in the Northwest, and above the national average, which rose 9.1 percent. The consumer price index for Washington rose 4.9 points to 121.2. In the Northwest, largest employment gains were also made in Washington (4.1 percent). The State enjoyed a 42-month period of rising employment (January 1965 to July 1968) which ended with a gain of 221,000 workers on a seasonally adjusted basis. The major cause of this increase was the aerospace industry, which had almost doubled over the previous 3 years, and leveled off in 1968.

Washington suffered one of the worst periods of labor disputes in the history of the State. During the period April to July, approximately 8,000 workers were off due to direct involvement in labor-management disputes. Particularly hit were the construction and metal trades industries, communications, and transportation equipment sectors. The metals industry had rebounded substantially at yearend, but, because of the disputes, the annual employment aver-

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[4] Sampson, Roy J. Transport Requirements for the Pacific Northwest Economic Development. Oregon Bus. Rev., v. 27, No. 8, August 1968, pp. 1, 5, 6.

Table 2.—Value of mineral production in Washington, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Adams	$395	$506	Sand and gravel, stone.
Asotin	W	64	Stone, sand and gravel.
Benton	534	452	Do.
Chelan	496	W	Stone, sand and gravel, pumice.
Clallam	143	215	Sand and gravel.
Clark	881	1,173	Sand and gravel, stone, clays.
Columbia	6,262	W	Sand and gravel, stone.
Cowlitz	391	945	Stone, sand and gravel.
Douglas	149	W	Stone, sand and gravel, clays.
Ferry	W	W	Gold, silver, stone, copper.
Franklin	2,240	W	Sand and gravel, stone.
Garfield	2,029	188	Stone, sand and gravel.
Grant	2,185	2,068	Diatomite, lime, sand and gravel, stone.
Grays Harbor	925	743	Sand and gravel, stone.
Island	160	W	Sand and gravel.
Jefferson	W	W	Stone, sand and gravel.
King	17,570	19,691	Cement, sand and gravel, stone, coal, clays, peat.
Kitsap	334	455	Sand and gravel, stone, peat.
Kittitas	1,903	1,054	Stone, sand and gravel.
Klickitat	663	203	Sand and gravel, stone.
Lewis	466	1,374	Stone, coal, sand and gravel, mercury, clays.
Lincoln	207	508	Sand and gravel, stone.
Mason	86	125	Sand and gravel, stone, peat.
Okanogan	327	181	Sand and gravel, stone, gypsum, silver, lead, zinc.
Pacific	211	266	Stone.
Pend Oreille	4,728	5,645	Cement, lead, zinc, stone, sand and gravel, silver, copper, gold.
Pierce	4,954	4,938	Sand and gravel, lime, stone, clays, peat.
San Juan	W	618	Sand and gravel, stone.
Skagit	5,059	5,189	Cement, olivine, stone, sand and gravel, soapstone.
Skamania	165	528	Stone, sand and gravel.
Snohomish	3,066	3,709	Sand and gravel, stone, peat, clays, copper, gold, silver.
Spokane	3,276	2,776	Sand and gravel, stone, clays, cement, peat.
Stevens	W	4,021	Zinc, stone, magnesite, lead, sand and gravel, silver, copper, clays, gold.
Thurston	305	627	Sand and gravel, coal, peat, stone.
Wahkiakum	(1)	W	Stone, sand and gravel.
Walla Walla	676	526	Sand and gravel, stone.
Whatcom	W	W	Cement, sand and gravel, stone, clays.
Whitman	983	5,947	Sand and gravel, stone.
Yakima	1,264	1,378	Sand and gravel, stone, lime.
Undistributed [2]	19,034	15,272	
Total	82,067	81,385	

W Withheld to avoid disclosing individual company confidential data.

[1] Less than ½ unit.

[2] Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

Table 3.—Indicators of Washington business activity

		1967	1968 [p]	Change (percent)
Employment and labor force, annual average:				
Total labor force	thousands	1,313.9	1,368.4	+4.1
Unemployment	do	56.4	58.6	+3.9
Employment:				
Construction	do	56.3	58.3	+3.6
Aerospace	do	98.7	104.5	+5.9
Lumber and wood products	do	44.0	45.7	+3.9
Food processing	do	29.6	29.3	−1.0
All manufacturing	do	277.1	286.1	+3.2
All industries	do	1,256.6	1,306.9	+4.0
Factory payrolls	millions	$5,167.7	$5,752.9	+11.3
Personal income:				
Total	do	$10,871.0	$12,044.0	+10.8
Per capita		$3,389.0	$3,676.0	+8.5
Construction activity:				
Building permits	millions	$782.0	(1)	------
Heavy engineering awards	do	$295.9	$289.9	−2.0
State highway commission:				
Value of contracts awarded	do	$105.5	$69.7	−34.0
Value of contract work performed	do	$105.5	$104.2	−1.2
Cement shipments to and within Washington	thousand 376-pound barrels	7,368.3	6,725.0	−8.7
Farm marketing receipts	millions	$781.7	$794.9	+1.7
Mineral production	do	$82.1	$81.4	−0.8

[p] Preliminary.

[1] Data no longer available, see text.

Sources: Survey of Current Business, Construction Review, Pacific Builder & Engineer, Washington State Highway Commission, The Farm Income Situation, Washington Employment Security Department, and Bureau of Mines.

Table 4.—Annual employment and total wages in the mineral industries

Industry	1967		1968	
	Employment	Wages (thousands)	Employment	Wages (thousands)
Mining:				
Metal mining	485	$3,490	414	$3,245
Bituminous coal, crude petroleum, and natural gas	88	607	79	530
Nonmetallic mining and quarrying	1,185	10,304	1,091	9,726
Total [1]	1,758	14,401	1,584	13,501
Stone, clay, and glass products:				
Cement, hydraulic	535	4,329	482	4,110
Structural clay products	298	1,712	308	1,869
Concrete, gypsum, and plaster products	3,727	30,029	4,026	34,665
Other	977	7,206	1,063	8,481
Total [1]	5,537	43,276	5,879	49,125
Smelting, refining, and casting:				
Blast furnaces, steel works, rolling and finishing mills	1,774	13,387	1,785	14,283
Iron and steel foundries	1,135	9,007	1,137	9,027
Smelting, refining, and casting of nonferrous metals, except aluminum	962	6,896	1,157	9,014
Smelting, rolling, drawing, and casting of aluminum	8,784	72,518	9,192	81,863
Miscellaneous	517	4,824	394	3,719
Total [1]	13,172	106,682	13,665	117,906
Industrial chemicals [2]	5,094	47,934	4,612	45,292
Petroleum refining and related industries	1,211	10,672	1,246	11,524
Grand total [1]	26,772	222,915	26,986	237,347

[1] Data may not add to totals shown because of independent rounding.
[2] The Hanford atomic plant is the largest in this classification.

Source: Washington Employment Security Department bulletins on industries covered by Washington State Employment Security Act. Industry groups may vary from those in the Bureau of Mines canvass.

Table 5.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	45	151	7	53	-------	9	168.80	5,008
Peat	30	192	6	47	-------	1	21.30	2,130
Metal	370	211	78	624	-------	34	54.46	1,451
Nonmetal	130	107	14	111	-------	4	36.12	740
Sand and gravel	1,582	202	320	2,585	-------	65	25.14	1,204
Stone	1,272	197	250	2,007	-------	29	14.45	524
Total	3,429	197	675	5,428	-------	142	26.16	1,017
1968: p								
Coal	45	153	7	52	-------	9	171.77	5,153
Peat	27	147	4	31	-------	-------	-------	-------
Metal	200	255	53	426	-------	42	98.55	2,335
Nonmetal	100	94	9	74	-------	3	40.75	1,453
Sand and gravel	1,405	205	287	2,297	2	57	25.68	9,329
Stone	1,200	208	250	2,007	3	21	11.96	9,363
Total	2,970	205	611	4,888	5	132	28.03	8,510

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Table 6.—Office of Minerals Exploration contracts active during 1968

County and contractor	Commodity	Contract		
		Date	Total amount	Government participation (percent)
Pierce: B & J	Mercury	Oct. 2, 1968	$41,200	75

age did not reflect an impressive growth trend.

Plant expansion and increased production in the nonferrous metals—primarily aluminum—brought employment to its highest level in that industry since 1957. Secondary industries enjoyed the growth experienced by the manufacturing sectors for the previous 2 years.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasives.—Carborundum Co., manufacturing silicon carbide at Vancouver, Clark County, continued shipping much of the crude product to abrasive-grain sizing and treatment plants in Eastern United States for further processing into material suitable for bonded and other abrasive products.

Cement.—Shipments of portland cement by four firms operating five plants totaled 6.3 million barrels valued at $23 million. Cement from the five plants and from 10 distribution terminals was distributed to consumers in the State (77 percent), and to other Pacific Northwest States and Alaska. Of the total cement shipped, 71 percent was transported by truck, 19 percent by rail, and 10 percent by boat. The ratio of bulk to paper bag shipments was about 12:1.

About 84 percent of the portland cement produced was distributed to firms manufacturing commercial concrete products, such as ready-mixed concrete companies (70 percent), concrete product manufacturers (10 percent), and building material dealers (4 percent). The remaining 16 percent was sold to highway (7 percent) and other contractors (4 percent), and to miscellaneous customers and Federal, State, and local government agencies (5 percent).

Lone Star Cement Corp. announced plans to consolidate its Pacific Northwest cement operations by expanding and modernizing facilities at Seattle, and phasing out cement operations at Concrete. Limestone quarrying operations were ceased at the company Lang quarry during the year.

Construction of a proposed cement plant at Seattle was postponed indefinitely by Kaiser Cement & Gypsum Corp. Tentative plans involved constructing the facility adjacent to the company cement storage complex at a Duwamish Waterway site.

Columbia Cement Co., Division of PPG Industries, Inc. announced plans to improve the Bellingham plant. An additional cement distribution terminal was included in the planned expansion to assist transportation-development efforts from the company cement shipping center at Harbor Island, Seattle.

Oregon Portland Cement Co. began delivering cement in bulk from a distribution terminal at Auburn.

Clays.—The quantity of clays sold or used by Washington producers increased 8 percent over the 1967 total, largely because more clays were used for refractory purposes.

Fire clay was mined from five pits in three counties. International Pipe & Ceramics Corp. continued producing firebrick from material dug at the Blum and Harris pits in King County. The firm dug clay from the Mica and Sommer pits, Spokane County, for use in manufacturing refractories at the Mica plant. Wenatchee Silica Sand, Inc., sold fire clay from a pit in Douglas County.

Miscellaneous clay for manufacturing cement and for making heavy clay products (building brick and vitrified pipe) came from nine pits in seven counties. International Pipe & Ceramics Corp. dug clay for manufacturing building brick and vitrified pipe from the Palmer and Pit 55 pits (King County) and the Lande pit (Stevens County). Mutual Materials Co. produced clay for use in making building brick from the Elk and Newcastle pits (King County) and the Clay City pit (Pierce County). Clay for manufacturing building brick also came from operations of Hidden Brick Co. (Clark County), Chehalis Brick & Tile Co. (Lewis County), and Lowell Brick Co. (Snohomish County). Clay from the Squalicum pit, dug by Lind Gravel Co., was used in manufacturing cement.

Diatomite.—The tonnage of diatomite production did not change significantly from the 1967 total. Kenite Corp. mined diatomite at a pit southeast of Quincy (Grant County) and trucked the material 18 miles to a company calcining plant at Quincy. The processed diatomite was marketed as a filtering aid, as a filler, and for insulation purposes.

Gem Stones.—A reported discovery of nephrite jade was announced.[5]

Gypsum.—Gypsite (a mixture of gypsum, quartz, and clay) from the Poison Lake deposit was processed at Tonasket by Agro Minerals, Inc., and sold for agricultural purposes. Crude gypsum, imported from Baja California, Mexico, by Kaiser Gypsum Co., Inc., was processed at Seattle and used in making building products. Some gypsum from the foreign source was marketed as a cement retarder. Gypsum from Canada was marketed by Greenacres Gypsum Co., Spokane, for agricultural purposes.

Lime.—Output of lime advanced 26 percent above the 1967 total. Pacific Lime, Inc., Tacoma, manufactured primary lime and marketed it for a wide variety of chemical uses, and for construction and agricultural purposes. Limestone for the Tacoma operation was imported from company quarries at Texada Island, British Columbia, Canada. Limestone transported from Lime, Oreg., was calcined to lime for use in sugar refining at Utah-Idaho Sugar Co. plants at Moses Lake, Grant County, and at Toppenish, Yakima County. Calcium carbonate sludge was converted to lime at eight pulping operations for their own use in manufacturing pulp and paper products.

Magnesian Minerals.—Crude magnesite output from operations at the Red Marble and Finch quarries by Northwest Magnesite Co., a subsidiary of Harbison-Walker Refractories Co., declined 29 percent from the 1967 total. The company Chewelah plant and Stevens County magnesite deposits were included in the Dresser Industries, Inc., acquisition of Harbison-Walker Refractories Co. early in the year. The magnesite, used as a furnace lining for steel manufacturing, was not adaptable and was not responsive to techniques used by Dresser Industries, Inc., and elsewhere; after 51 years functioning as a supplier of magnesite to the steel industry in the Eastern United States, the Northwest Magnesite Co. operations at Chewelah were shut down in October. Competition with foreign magnesite producers also was a reason for closing the operation. Refractory brick, used as a liner in steelmaking furnaces and kilns, was imported from Japan to steel mills in the Eastern United States at less cost than from Chewelah.

Olivine production, advancing 11 percent over the 1967 output, was marketed principally for use as foundry sand to consumers in the Western States and Canada. Crude material from Skagit County quarries was processed at plants of Northwest-International (formerly Northwest Olivine Corp.), Hamilton, Skagit County, and Olivine Corp., Bellingham, Whatcom County.

International Minerals & Chemicals Corp. (IMC), a major producer of phosphate, chemicals, and industrial minerals, acquired the mining and processing assets of Northwest Olivine Co. The Northwest Olivine Co. organization continued operating the mining and olivine processing operations after the purchase.

Pumice.—Ewer Lumber Co., the only producer, continued to mine pumice from a pit near the southeastern part of Chelan Lake, Chelan County. The screened material was sold to Pacific Northwest and Canadian consumers for use in manufacturing building blocks.

Sand and Gravel.—Sand and gravel output increased 12 percent over the 1967 total owing to greater requirements by the U.S. Army Corps of Engineers at dam construction projects.

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[5] McLeod, D. L. Nephrite Jade Has Been Discovered in Washington. Lapidary J., November 1968, pp. 1034–1037.

Sand and gravel was produced in 37 of the 39 counties. Commercial firms operated 114 plants—82 stationary and 32 portable. Output from Government-and-contractor operations (largely production by Federal, State, and local government agencies) for roadbuilding and dam construction projects was from 69 plants—21 stationary and 48 portable.

Sand and gravel output was valued at over $4 million in King County, more than $3 million each in Whitman, Snohomish, and Pierce Counties, and greater than $2 million in Spokane County.

Distribution of output by use was as follows: Roadbuilding and maintenance, 43 percent; construction, 24 percent; fill, 29 percent; railroad ballast, less than 1 percent; and miscellaneous, 4 percent. Included under miscellaneous were small but important quantities of special industrial silica sands used for glass manufacturing and sandblasting.

Raw material supply problems of Yakima Cement Products Co., Yakima, Yakima County, in producing sand and gravel and bituminous concrete aggregates to meet growing demand and changing specifications and requirements were described in a report.[6]

Stone.—Stone was quarried in 37 counties. King and Whitman Counties each had production valued at over $2 million. Stone output in King County was used largely in road construction, while that from Whitman County was used in dam construction on the Snake River. Basalt production totaling 12.7 million tons from operations in 31 counties was 88 percent of the stone total.

Limestone production of 1 million tons valued at $1.5 million came from 11 quarrying operations—one each in King, Okanogan, Pend Oreille, San Juan, Skagit, and Snohomish Counties; three in Stevens County; and two in Whatcom County. A large part of the limestone produced was used by the cement industry; some was used in manufacturing lime, and for agricultural purposes, and by the pulp and paper and metallurgical industries. Large quantities of limestone were imported for use in manufacturing cement, lime, and paper. The Tonasket Lime Products Co. operation at Spectacle Lake, Okanogan County, was described.[7]

Table 7.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	6,242	$7,406	7,410	$8,032
Road material	6,586	6,368	7,786	7,861
Fill	2,628	1,546	2,594	1,570
Railroad ballast	151	104	167	115
Other [1]	1,534	2,049	754	1,244
Total	17,141	17,473	18,711	18,822
Government-and-contractor operations:				
Building	329	455	2	2
Road material	8,223	6,822	5,699	4,512
Fill	553	289	6,394	3,789
Other [1]	1,918	2,481	626	714
Total	11,023	10,047	12,721	9,017
All operations:				
Building	6,571	7,861	7,412	8,034
Road material	14,809	13,190	13,485	12,373
Fill	3,181	1,835	8,988	5,359
Railroad ballast	151	104	167	115
Other [1]	3,452	4,530	1,380	1,958
Total	28,164	27,520	31,432	27,839

[1] Includes special sands for construction and industrial uses and sand and gravel for miscellaneous unspecified purposes.

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[6] Trauffer, Walter E. Washington Gravel Firm Adjusts and Expands to Meet Changing Needs. Pit and Quarry, v. 60, No. 9, March 1968, pp. 98–103.

[7] Trauffer, Walter E. Small Plant in North Central Washington Produces Agstone Feeds. Pit and Quarry, v. 60, No. 11, May 1968, pp. 137–139.

Table 8.—Stone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967		1968	
	Quantity	Value	Quantity	Value
Dimension stone (building)	41	$819	13	$330
Concrete and roadstone	8,870	11,775	7,429	9,226
Riprap	915	1,514	978	1,622
Other [1]	4,629	5,491	5,911	5,512
Total [2]	14,454	19,099	14,331	16,690

[1] Used at cement, paper, metallurgical, and chemical plants, for railroad ballast, and miscellaneous unspecified purposes.

[2] Data may not add to totals shown because of independent rounding.

Sandstone, quartz, and quartzite output for use as industrial silica totaled 171,428 tons valued at $1,019,307. The silica came from quarrying operations in Chelan, Pend Oreille, Pierce, Spokane, Stevens, and Skagit Counties. It was used in manufacturing abrasives, cement, ferrosilicon, glass, sodium silicate, and for foundry applications. Dimension sandstone was produced in Ferry and Pierce Counties. The quarrying operation at the Wilkeson sandstone quarry, Pierce County, by Wilkeson Cut Stone Co., was described in a report.[8]

Granite for poultry grit, riprap, and roadstone came from two quarrying operations in both King and Okanogan Counties and from one quarry in both Ferry and Skagit Counties. Dimension granite was produced at two quarries in King County and at one quarry in Yakima County.

Marble from three quarries in Stevens County was marketed for use as terrazzo, and for other construction purposes. Dimension marble came from one quarry in Stevens County.

Talc and Soapstone.—Soapstone was mined at two operations near Marblemount, Skagit County. The crude material was ground at plants of Northwest Talc & Magnesium Co., Clear Lake, and Stauffer Chemical Co., Portland, Oreg. The processed material was used as a carrier in insecticides and fertilizers, and as a filler for paint. Some of the crude output continued to be sold for sculpturing purposes.

Vermiculite.—Crude vermiculite from a Montana mining operation was exfoliated at the Spokane plant of Vermiculite Northwest, Inc. The expanded product was sold for use in insulation, concrete aggregates, and for agricultural purposes.

METALS

Aluminum.—Aluminum output increased 3.9 percent to 775,419 short tons compared with 746,321 short tons produced in 1967. The value increased 6.5 percent over the 1967 total of $370.3 million to $394.3 million. Total productive capacity was increased 28.3 percent to 988,000 short tons per year.

Reynolds Metals Co. added a new 40,000-ton-per-year potline at Longview boosting annual capacity to 110,000 tons. Projected additions were to increase capacity to 190,000 tons per year by 1970.

Annual capacity at the Ferndale plant of Intalco Aluminum Corp., was increased from 228,000 tons to 270,000 tons with the completion of a new potline in November.

A process line for automatic and continuous heat-treating of aluminum sheet coils was placed in operation by Kaiser Aluminum & Chemical Corp. at its Trentwood works. At the Tacoma plant, a new aluminum rod mill was started in December. By July 1969, the Tacoma plant capacity was to be increased to 80,000 tons per year.

Harvey Aluminum, Inc., signed a contract to purchase 200,000 kilowatts of power to operate a new 100,000-ton-per-year aluminum smelter to be built near John Day Dam. Raw material for the facility was to come from the company's alumina plant on St. Croix, Virgin Islands.

The Port of Everett announced an agreement with the Anaconda Aluminum Co. to finance a $3.3 million alumina transfer facility on the Everett waterfront. Anaconda planned to ship 350,000 tons of Jamaican

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[8] Northern Pacific Railway Co. Quarrying Wilkeson's Sandstone. The Northwest, v. 42, No. 3, May–June 1968, pp. 13–15.

Table 9.—Primary aluminum plant capacity and production data

Year	Rated primary capacity, thousand short tons	Primary production			Average U.S. ingot price per pound, cents
		Thousand short tons	Percent of national total	Value (thousands)	
1964	483	490	19	$232,893	23.7
1965	524	585	19	262,702	24.5
1966	676	598	20	294,115	24.5
1967	770	746	23	370,287	25.0
1968	988	775	24	394,261	25.1

alumina per year through Everett enroute to Anaconda's Columbia Falls, Mont., reduction plant.

Beryllium.—The Bureau of Mines published a report on beryllium deposits in the Northwest.[9] Among the areas included were Calispell Peak and Granite-Ruby Creek, South Baldy, and the Silver Hill mine. Beryllium was found in low-grade quartz veins and idocrase tactites. The study was done as part of a nationwide study of the national beryllium supply. Increased demand had been anticipated in supersonic aircraft, missiles, nuclear reactors, and space vehicles.

Copper.—Mono Mine, Inc., announced plans for a 200-ton-per-day mill at its King County property 60 miles east of Seattle. An estimated 225,000 tons of 1.5 percent copper ore was reported to have been blocked out.

Copper Chief Mining Co. reported uncovering promising copper mineralization along with some gold and silver beneath a capping of iron ore at the Big Iron mine in northern Stevens County. Diamond drilling was planned for 1969.

As a result of surface diamond drilling on its Middle Fork property, 50 miles east of Seattle, Westland Mines, Ltd., estimated an inferred potential of 32 million tons of copper-silver mineralization reported to have an approximate value of $12 per ton.

Gold-Silver.—Gold production decreased 27 percent in quantity compared with that of 1967. Silver output increased only 19.5 percent in quantity, but the value increased 65.3 percent over that of 1967. The increase in value of silver reflected the higher average price for 1968. Most of the recorded gold production came from the Knob Hill mine in Ferry County. Silver produced as a byproduct from lead-zinc concentrate was 7.5 percent of total production.

Diamond drilling at two long-idle gold mines in the Republic district, Ferry County, was undertaken by Knob Hill Mines, Inc., and Day Mines, Inc., on a joint venture basis.

Gold Placers, Inc., resumed operations at its gold placer property in the Swauk mining district, Kittitas County. Overburden of 30 feet was to be removed to get at 10 feet of gold-bearing material over bedrock. After mining, plans included reclaiming and landscaping mined-out areas for future use as home sites.

Iron Ore.—Spokane National Mines, Inc., leased the Jim Hill mine in Stevens County. Hematite iron ore, reported to contain 55 percent iron, was shipped at the turn of the century to the Tacoma smelter.

Lead-Zinc.—Production of lead increased 105 percent over that for 1967, while zinc production declined 35 percent to the lowest output recorded since 1949. Lead production was 5,655 short tons valued at $1.5 million, and 13,884 tons of zinc was produced valued at $3.7 million. Major production came from the Pend Oreille mine (Pend Oreille County) and the Calhoun mine (Stevens County).

Closure of the Calhoun mine by the American Zinc Co. in October and reduced tonnage milled at the Pend Oreille mine caused the drop in zinc output. Mining of ore with higher lead content at the Pend Oreille mine contributed to the increase in lead production.

Results of the rigid grade-control program initiated at the Pend Oreille mine were encouraging, and the program continued. According to the company annual report, 197,826 tons of ore was milled compared with 292,628 tons milled in the 6 months of operation in 1967 prior to the strike which shut the mine down for the latter part of the year. Receipts from concentrates were $1.5 million compared with $1.2 million in 1967. More selective mining methods and increased costs of labor and supplies raised total costs per ton to $6.707 compared with $4.521 in the operating period of 1967. Through 1968, the property had yielded 12,578,538 tons of ore and paid $6,871,371.71 in dividends. In 1968, a tailings pond was completed, and tailings were no longer discharged into the Pend Oreille River.

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[9] Pattee, Eldon C., Ronald M. Van Noy, and Robert D. Weldin. Beryllium Resources of Idaho, Washington, Montana, and Oregon. BuMines Rept. of Inv. 7148, 1968, 169 pp.

Mercury.—Mercury production from the Morton area, Lewis County, was reported for the first time since 1965.

Uranium.—No production of uranium was reported. However, much prospecting was in progress in and around the Spokane Indian Reservation.

Evergreen Gas & Oil Co., Silver Hill Mines, Inc., Cordero Mining Co., and Spokane National Mines, Inc., obtained prospecting permits on the reservation.

Empire Explorations, Inc., Daybreak Mines, Inc., and Idaho General Mines, Inc., prospected on 1,500 acres in Lincoln County.

Western Nuclear, Inc., announced plans for constructing a plant to produce over 1 million pounds of uranium oxide yearly. Plant construction and preliminary stripping were scheduled to start in 1969.

Dawn Mining Co. reported a non-Government market for uranium oxide worth $18.5 million, with delivery to commence in 1970. Mill rehabilitation and production were scheduled for 1969.

MINERAL FUELS

Carbon Dioxide.—Gas-Ice Corp. ceased recovering carbon dioxide from mineral waters in Klickitat County. The firm continued maintaining a plant at Finley, Benton County, where carbon dioxide was recovered from an ammonia-plant waste product.

Coal.—Coal output, all from five mines in the Puget Sound area west of the Cascade Range, totaled 177,730 tons, about triple the tonnage produced in 1967.

Washington Irrigation & Development Co. removed 125,000 tons of coal from a test pit site at the Tono coalfield for preparatory development of a powerplant operation by Pacific Power & Light Co. (PP&L) and Washington Water Power Co. (WWP). Pacific Sand & Gravel Co. hauled the coal to the powerplant site about 6 miles northeast of Centralia for future use in determining washing and other beneficiation requirements of the coal. Washing tests conducted on 500 tons from the test pit confirmed prior laboratory analysis and showed that the coal was upgraded substantially through washing to remove noncombustibles, thereby increasing the heat value and lowering the ash content.

Ceremonies held August 23 marked the beginning of construction on a $206 million coal-fired steam-electric power plant of PP&L and WWP. Site preparation was underway in August by Morrison-Knudsen Co., Inc., general contractor for the initial work on the 1,400-megawatt generating unit. The first of two steam-heat circulation boilers was ordered from Combustion Engineering Corp., Windsor, Conn. Coal consumption at the plant was expected to average 4.8 million tons annually with two 700-megawatt generating units operating.

PP&L and WWP conducted preliminary field examination in the Centralia coalfield in 1957, and began an acquisition program for land and mining rights. The Centralia project development covered about 21,000 acres of property, of which 8,670 acres was classified as mining field area. An estimated 85 percent of the total land area was forested, and the remaining 15 percent was agricultural land, principally used for hay or pasture. Approximately 5,600 acres was expected to be disturbed by mining over the planned 35-year plant operation. On the average, the company planned to disturb about 160 acres of land annually, depending upon thickness of the coal seam being mined.

General information about the Centralia steam-electric project was published.[10]

Peat.—Production of peat totaled 40,440 tons of which 24,365 tons was unprepared and 16,075 tons was shredded before marketing. The average unit value of peat was $3.93 per ton. Humus (5,706 tons), peat moss (8,652 tons), and reed-sedge (26,082 tons) peat were produced. Much of the peat was sold in bulk for soil improvement purposes.

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[10] Humphreys, P. G. Centralia Steam-Electric Project—A Story of Resource Development. Centralia Steam-Electric Project, 1968, 20 pp.

Petroleum and Natural Gas.—Five exploratory wells, all dry holes, were drilled for oil and gas. Two dry holes were drilled in Whatcom County, two in Lewis County, and one in Stevens County.

At Jackson Prairie, Lewis County, WWP, Washington Natural Gas Co., and El Paso Natural Gas Co. continued developing a natural gas storage reservoir with a capacity of 25 billion cubic feet by drilling 12 storage-test wells.

Atlantic Richfield Co. announced plans for constructing a 100,000-barrel-per-day petroleum refinery at Cherry Point on the Strait of Georgia, 11 miles northwest of Bellingham. The firm dropped plans for locating the refinery near Marysville, Snohomish County, on Point Susan Bay. Preservationist groups opposed construction of the oil refinery at Marysville and attempted to block the development through the Snohomish County Planning Commission. The company decided its urgent need for the refinery would not permit an indeterminate delay anticipated from court review of Snohomish County's zoning approval of the project. Petroleum discoveries on Alaska's North Slope made jointly by Atlantic Richfield and Humble Oil & Refining Co. advanced an anticipated need by the company for high-volume refining capacity in the Pacific Northwest.

Table 10.—Oil and gas well drilling in Washington

County	Exploratory wells: [1] Dry	Total footage
Lewis	2	4,129
Stevens	1	3,070
Whatcom	2	11,029

[1] No oil or gas completions.

Structural and surface features, and previous petroleum exploration on the Wynoochee Valley anticline, Grays Harbor County, were described in a report.[11]

Stratigraphic sequence of rock units and previous petroleum exploration in the Grays River area of southwestern Washington were the subjects of a report.[12]

Operation of the largest petroleum products pipeline on the west coast was described.[13]

Maintenance areas, degree of automation, and districts of Pacific Gas Transmission natural gas transmission line from Alberta, Canada, to California, through Idaho, Washington, and Oregon were the subjects of a report.[14]

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
NONMETALS			
Cement:			
Columbia Cement Co	Bellingham, Wash. 98225	Plant	Whatcom.
Ideal Cement Co	5400 W. Marginal Way SW. Seattle, Wash.	do	King.
Lehigh Portland Cement Co.	Metaline Falls, Wash. 98108	do	Pend Oreille.
Lone Star Cement Corp	Concrete, Wash	do	Skagit.
Do	P.O. Box 2047, Seattle, Wash. 98111	do	King.
Clay:			
Chehalis Brick & Tile Co	Chehalis, Wash. 98532	Pit and plant	Lewis.
Hidden Brick Co	Vancouver, Wash. 98600	do	Clark.
International Pipe & Ceramics Corp.	2901 Los Feliz Blvd. Los Angeles, Calif. 90027		
Blum	Enumclaw, Wash. 98022	Pit	King.
Harris	Issaquah, Wash. 98027	Pit	Do.
Lande	Deer Park, Wash. 99006	Pit	Stevens.
Mica	Mica, Wash. 99023	Pit and plant	Spokane.
Palmer	Enumclaw, Wash. 98022	Pit	King.
Pit #55	Kenmore, Wash. 98028	Pit	Do.
Sommer Lease	Mica, Wash. 99023	Pit and plant	Spokane.
Lind Gravel Co	Bellingham, Wash. 98225	Pit	Whatcom.
Lowell Brick Co	Everett, Wash. 98201	Pit and plant	Snohomish.

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[11] Rau, Weldon W. Geology of the Wynoochee Valley Quadrangle, Grays Harbor County. State of Washington, Div. of Mines and Geology, Bull. 56, 1967, 51 pp.

[12] Wolfe, Edward W., and Edwin H. McKee. Geology of the Grays River Quadrangle. State of Washington, Div. of Mines and Geology, Geologic Map GM-4, 1968, 6 pp.

[13] O'Donnell, John P. Olympic Pipeline's First Objective Is Quality Control. Oil and Gas J., v. 66, No. 6, June 24, 1968, pp. 106–108.

[14] O'Donnell, John P. Unmanned Compressor Stations Work Well. Oil and Gas J., v. 66, No. 12, Mar. 16, 1968, pp. 71–74.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
NONMETALS—Continued			
Clay—Continued			
Mutual Materials Co	P.O. Box 3547 Seattle, Wash. 982224	Pit and plant	King, Pierce.
Wenatchee Silica Sand	Wenatchee, Wash. 98801	Pit	Douglas.
Diatomite: Kenite Corp	Overhill Bldg. Scarsdale, N.Y. 10583	Mine and plant	Grant.
Gypsum:			
Agro Minerals, Inc	Tonasket, Wash. 98855	Mine	Okanogan.
Kaiser Gypsum Co., Inc	5931 E. Marginal Way S. Seattle, Wash. 98134	Plant	King.
Lime: Pacific Lime, Inc	1220 Alexander Ave. Tacoma, Wash. 98421	do	Pierce.
Magnesite: Northwest Magnesite Co.	Chewelah, Wash. 99109	Mine and plant	Stevens.
Olivine:			
Northwest International	Mount Vernon, Wash. 98273	do	Skagit.
Olivine Corp	Bellingham, Wash. 98225	do	Do.
H. P. Scheel or Scheel Stone Co.	8314 Harbor Ave., SW Seattle, Wash. 98126	Mine	Do.
Pumice and pumicite: Ewer Lumber Co.	Omak, Wash. 98841	Pit and plant	Chelan.
Roofing granules: Northwest Talc & Magnesium Co.	Clearlake, Wash. 98235	Plant	Skagit.
Sand and gravel:			
Ace Concrete Co	N. 302 Park Rd. Dishman, Wash. 99213	Pit and plant	Spokane.
Arlington Sand & Gravel Co.	Arlington, Wash. 98223	do	Snohomish.
Associated Sand & Gravel Co., Inc.	6600 Glenwood Ave. Everett, Wash. 98201	do	Do.
Cadman Gravel Co	Redmond, Wash. 98052	do	King.
Cascade Asphalt Paving Co.	6238 S. Tacoma Way Tacoma, Wash. 98409	do	Pierce.
Central Pre-Mix Concrete Co.	805 N. Division St. Spokane, Wash. 99202	do	Spokane.
Curtis Construction Co	Pomeroy, Wash. 99347	do	Columbia.
DeAtley Corp	Sprague, Wash. 99032	do	Adams.
Eby Sand & Gravel	Edmonds, Wash. 98020	do	Snohomish.
Edinger Gravel Co., Inc	Kenmore, Wash. 98028	do	Do.
Friday Harbor Sand & Gravel	Bellingham, Wash. 98225	do	San Juan.
Glacier Sand & Gravel Co.	5975 E. Marginal Way, Seattle, Wash. 98134	do	King.
Holroyd Land Co., Inc	7216 Custer Rd. W. Tacoma, Wash. 98467	do	Pierce.
Peter Kiewit Sons Co	P.O. Box 1777 Vancouver, Wash. 98463	do	Kittitas.
Lakeside Gravel Co., Inc	Bellevue, Wash. 98004	do	King.
Marine Asphalt Co., Inc	Anacortes, Wash. 98221	do	Various.
Materne Bros	Box 0, Rosewood Station Spokane, Wash. 99200	do	Spokane.
Miles Sand & Gravel Co	Auburn, Wash. 98002	do	King.
North Kitsap Gravel & Asphalt Co.	Poulsbo, Wash. 98370	do	Kitsap.
North Star Sand & Gravel	Box 398 Lynwood, Wash. 98036	do	Snohomish.
Olympia Oil & Wood	Olympia, Wash. 98501	do	Thurston.
Pioneer Sand & Gravel Co	P.O. Box 1881 Seattle, Wash. 98111	do	Pierce.
Quigg Bros. McDonald Inc.	Aberdeen, Wash. 98520	do	Grays Harbor.
Ray Weist Contractor	Yakima, Wash. 98900	do	Yakima.
Reid Sand & Gravel Co	Bellevue, Wash. 98004	do	King.
Renton Sand & Gravel	Renton, Wash. 98055	do	Do.
S & S Sand & Gravel, Inc	Ephrata, Wash. 98823	do	Various.
Western Sand & Gravel Co	Maple Valley, Wash. 98038	do	King.
Wilder Construction Co	Bellingham, Wash. 98225	do	Whatcom.
Woodworth & Co., Inc	1200 E. D St. Tacoma, Wash. 98421	do	Pierce.
Yakima Cement Products Co.	Yakima, Wash. 98900	do	Yakima.
Sillcon carbide: The Carborundum Co.	Lower River Rd. Vancouver, Wash. 98660	Plant	Clark.
Stone:			
Black River Quarry	6808 S. 140th Seattle, Wash. 98178	Quarry and plant	King.
Carl Carbon, Inc	Box 5153, N. Central Station Spokane, Wash. 99205	do	Spokane.
C & E Construction Co	Yakima, Wash. 98900	do	Benton, Franklin.
Columbia Cement Co	Bellingham, Wash. 98225	do	Whatcom.
DeAtley Corp	P.O. Box 648 Lewiston, Idaho 83501	do	Various.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
NONMETALS—Continued			
Stone—Continued			
General Construction Co	P.O. Box 3845 Seattle, Wash. 98124	Quarry and plant	Jefferson.
Peter Kiewit Sons Co	P.O. Box 1777 Vancouver, Wash. 98463	do	Whitman.
Max J. Kuney	120 Ralph St. Spokane, Wash. 99202	do	Kittitas.
Lehigh Portland Cement Co.	Metaline Falls, Wash. 99153	do	Pend Oreille.
Lone Star Cement Corp	P.O. Box 2047 Seattle, Wash. 98111	do	King.
Lockheed Shipbuilding & Construction	12020 E. Marginal Way Seattle, Wash. 98168	do	Do.
S. S. Mullens	7329 Fourth Ave. S. Seattle, Wash. 98108	do	Whitman.
Murphy Bros	E. 3812 Broadway Spokane, Wash. 99202	do	Grant, Whitman.
MacGreggor Triangle	200 Sunrise Rim Boise, Idaho 83705	do	Whitman.
Pacific Sand & Gravel Co	Centralia, Wash. 98531	do	Cowlitz, Lewis, Thurston.
S & S Sand & Gravel, Inc	Ephrata, Wash. 98823	do	Kitsap.
Stewart-Erickson	Bellevue, Wash. 98004	do	Whitman.
D. A. Sullivan	Box 37, Parkwater Station Spokane, Wash. 99211	do	Spokane.
Verbeck Bros	Tonasket, Wash. 98855	do	Douglas, Okanogan.
Vinnell-Mannix-Fuller-Dillingham	Pomeroy, Wash. 99347	do	Columbia.
Weyerhaeuser Co	Longview, Wash. 98632	do	Various
Talc and soapstone:			
Northwest Talc & Magnesium Co.	Clearlake, Wash. 98235	Plant	Skagit.
Skagit Talc Products	Sedro-Woolley, Wash. 98284	Mine	Do.
Herman Smith	Marblemount, Wash. 98267	do	Do.
Vermiculite (exfoliated): Vermiculite-Northwest, Inc.	Auburn, Wash. 98002	Plant	Spokane.
METALS			
Aluminum:			
Aluminum Company of America.	Vancouver, Wash. 98600	Plant	Clark.
Do	Wenatchee, Wash. 98801	do	Chelan.
Intalco Aluminum Corp	Bellingham, Wash. 98225	do	Whatcom.
Kaiser Aluminum & Chemical Corp.	Spokane, Wash. 99200	do	Spokane.
Do	Tacoma, Wash. 98400	do	Pierce.
Reynolds Metals Co	Longview, Wash. 98632	do	Cowlitz.
Gold:			
Day Mines, Inc	Republic, Wash. 99166	Mine (lode)	Ferry.
Knob Hill Mines, Inc	do	Mine and mill	Do.
Copper:			
American Smelting and Refining Co.	Tacoma, Wash. 98400	Smelter	Pierce.
Kromona Consolidated Mines, Inc.	Lloyd Bldg. 6th & Stewart Seattle, Wash. 98101	Mine	Snohomish.
Lead-zinc:			
Cleveland Silver Mines, Inc.	5504 Northwest Blvd. Spokane, Wash. 99205	do	Stevens.
Pend Oreille Mines & Metals Co.	923 Old National Bank Bldg. Spokane, Wash. 99201	Mine and mill	Pend Oreille.
Zinc:			
American Zinc Co	Leadpoint, Wash. 99114	do	Stevens.
Calix American Corp	Colville, Wash. 99114	do	Do.
MINERAL FUELS			
Coal:			
Black Prince Coal Co	Centralia, Wash. 98531	Mine	Lewis.
Palmer Coking Coal Co	Black Diamond, Wash. 98010	do	King.
Queen Coal Co	Wilkeson, Wash. 98396	do	Pierce.
Stoker Coal Mining Co	Centralia, Wash. 98531	do	Thurston.
Washington Irrigation & Development Co.	do	do	Lewis.
Peat:			
Asbury Fuel Co	Bremerton, Wash. 98310	Bog	Kitsap.
Cunningham Sand & Gravel Co., Inc.	N. 6315 Cedar St. Spokane, Wash. 99208	Bog	Spokane.
Fuller's Soils	Lynnwood, Wash. 98036	Bog	Snohomish.
Harbor Heights Humus Co.	Gig Harbor, Wash. 98335	Bog	Pierce
Kildow Bros., Inc	Olympia, Wash. 98501	Bog	Thurston.
Maple Valley Humus	Renton, Wash. 98055	Bog	King.
Plant Food Co	Bothell, Wash. 98011	Bog	Snohomish.
Rhod-A-Zalea Gardens	do	Bog	Do.

The Mineral Industry of West Virginia

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the West Virginia Geological and Economic Survey for collecting information on all minerals except fuels.

By Meherwan C. Irani [1]

During 1968 West Virginia maintained its position as the leading coal-producing State in the Nation. Coal accounted for 85 percent of the State's mineral output value. Although production of 145.9 million tons was 5 percent lower than in 1967, the value declined by only 3 percent. Forty-four new coal mines, each employing 20 men or more, were opened.

The value of total mineral output in the State decreased by $20.2 million, a loss of 2.2 percent.

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[1] Metallurgist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in West Virginia [1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] ... thousand short tons	245	$254	193	$219
Coal (bituminous) ... do	153,749	800,683	145,921	775,720
Lime ... do	217	3,099	207	2,848
Natural gas ... million cubic feet	211,460	50,962	236,971	62,086
Petroleum (crude) ... thousand 42-gallon barrels	3,561	14,244	3,312	13,149
Salt ... thousand short tons	1,127	5,137	1,308	4,971
Sand and gravel ... do	5,827	12,167	5,657	11,900
Stone [3] ... do	9,445	16,447	9,011	16,789
Value of items that cannot be disclosed: Calcium-magnesium chloride (1967), cement (portland and masonry), fire clay, gem stones, natural gas liquids, and stone (dimension sandstone)	XX	34,865	XX	30,026
Total	XX	937,858	XX	917,708
Total 1957–59 constant dollars	XX	1,010,403	XX	p 945,062

p Preliminary. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fire clay; included with "Value of items that cannot be disclosed."

[3] Excludes certain stone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in West Virginia, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Barbour	$15,520	$14,871	Coal.
Berkeley	W	W	Cement, stone, lime, clays.
Boone	W	51,831	Coal.
Braxton	W	W	Stone, coal.
Brooke	3,345	3,817	Coal, sand and gravel, stone.
Cabell	W	40	Clay, sand and gravel.
Clay	250	W	Coal.
Doddridge	W	278	Stone.
Fayette	25,370	24,507	Coal.
Gilmer	1,535	W	Do.
Grant	9,310	W	Coal, stone.
Greenbrier	4,700	5,385	Do.
Hancock	W	6,996	Clays, sand and gravel, coal.
Hardy	46	52	Stone.
Harrison	32,391	W	Coal, stone.
Jackson	10	-------	
Jefferson	W	W	Stone, lime.
Kanawha	55,450	W	Coal, stone, clays.
Lewis	2,520	W	Do.
Lincoln	W	W	Clays.
Logan	86,454	80,531	Coal.
McDowell	119,216	116,459	Coal, stone.
Marion	77,233	70,198	Do.
Marshall	W	W	Coal, salt.
Mason	W	W	Coal, sand and gravel.
Mercer	W	W	Coal, clays.
Mineral	W	W	Coal, stone.
Mingo	28,593	24,539	Coal.
Monongalia	W	W	Coal, stone.
Monroe	-------	W	Sand and gravel.
Morgan	W	W	Do.
Nicholas	45,109	W	Coal, stone, sand and gravel.
Ohio	11,781	W	Coal, sand and gravel.
Pendleton	W	W	Stone, lime.
Pleasants	W	W	Sand and gravel, salt.
Pocahontas	W	W	Coal, stone.
Preston	W	W	Do.
Raleigh	W	W	Coal, stone, sand and gravel.
Randolph	W	W	Coal, stone.
Ritchie	2	8	Stone.
Roane	17	-------	
Taylor	W	W	Coal, clays.
Tucker	1,521	W	Coal, stone.
Tyler	W	W	Salt.
Upshur	2,585	1,901	Coal.
Wayne	432	W	Do.
Webster	2,089	1,004	Do.
Wetzel	W	W	Sand and gravel.
Wirt	-------	16	Stone.
Wood	W	W	Sand and gravel, stone.
Wyoming	W	W	Coal, sand and gravel.
Undistributed[2]	412,427	515,275	
Total[3]	937,858	917,708	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Calhoun, Hampshire, Putnam, and Summers Counties are not listed because no production was reported.

[2] Includes gem stones, natural gas, natural gas liquids, petroleum, some stone (1967) and salt, that cannot be assigned to specific counties, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

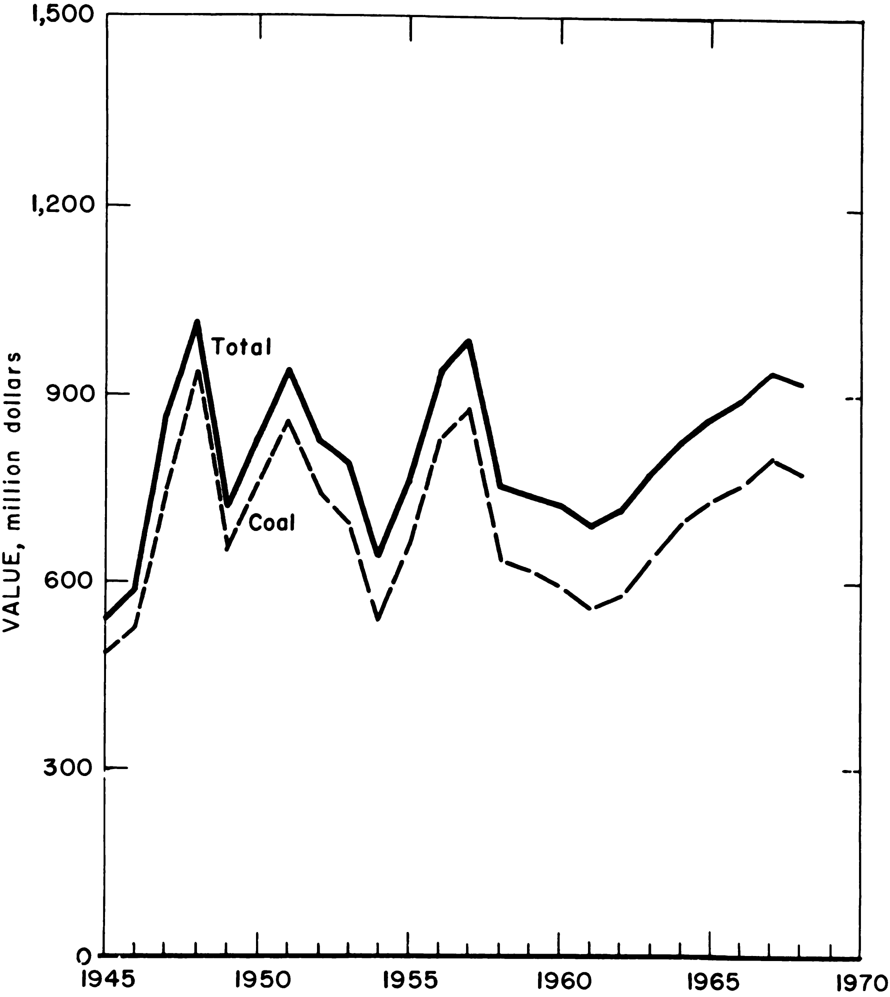

Figure 1.—Value of coal and total value of mineral production in West Virginia.

Table 3.—Indicators of West Virginia business activity

	1967	1968 p	Change (percent)
Employment and labor force, annual average: [1]			
Total labor force .... thousands..	625.4	628.4	+0.5
Unemployment .... percent of labor force..	6.3	6.4	+1.6
Employment:			
Manufacturing .... thousands..	133.2	132.3	—.7
Durable goods .... do....	81.1	80.5	—.7
Nondurable goods .... do....	52.1	51.8	—.6
Nonmanufacturing .... do....	370.4	375.3	+1.3
Mining .... do....	47.5	45.7	—3.8
Bituminous coal mining .... do....	42.6	41.1	—3.5
Contract construction .... do....	24.2	26.0	+7.4
Payroll average weekly earnings: [1]			
Manufacturing	$117.20	$122.43	+4.5
Durable goods	$118.80	$124.67	+4.9
Nondurable goods	$112.00	$118.04	+5.4
Personal income: [2]			
Total .... millions..	$4,197	$4,488	+6.9
Per capita	$2,323	$2,491	+7.2
Construction activity: [3]			
New housing units authorized	2,037	2,299	+12.8
Cement shipments to and within West Virginia thousand 376-pound barrels..	2,305	2,601	+12.9
Mineral production .... thousands..	$937,858	$917,708	—2.1

p Preliminary.

[1] Source: West Virginia Department of Employment Security.

[2] Source: Survey of Current Business, U.S. Department of Commerce.

[3] Source: Construction Reports, U.S. Department of Commerce.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1967:								
Coal	43,556	218	9,512	75,221	62	4,217	56.89	8,039
Nonmetal	785	248	195	1,559	-------	18	11.55	429
Sand and gravel	218	278	61	530	-------	13	24.52	792
Stone	1,155	280	323	2,600	1	42	16.54	2,716
Total	45,714	221	10,091	79,910	63	4,290	54.47	7,670
1968: p								
Coal	43,100	212	9,157	72,890	150	3,875	55.22	15,273
Nonmetal	775	312	242	1,934	1	14	7.76	3,495
Sand and gravel	215	267	57	505	-------	12	23.78	709
Stone	1,305	255	333	2,673	2	31	12.35	4,974
Total [1]	45,390	216	9,789	78,003	153	3,932	52.37	14,533

p Preliminary.

[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—West Virginia continued to be the leading coal-producing State in the Nation. The total production of 145.9 million tons was 8 million tons less than in 1967, a decrease of 5 percent. The value of coal mined decreased by 3 percent to $775.7 million in 1968.

The production of open-market coal totaled 126.7 million tons valued at $655 million, a decrease of 5 percent in quantity and 3 percent in value from that of 1967. Captive coal production, 19.2 million tons valued at $121 million, decreased 3 percent in quantity and 2 percent in value from 1967 levels. The average value per ton of coal rose to $5.32 from $5.21 in 1967.

There were 1,263 active mines with production in excess of 1,000 tons, a decrease of 133. Of the total output, 88 percent was mined at 934 underground operations, a decrease of 136; 8 percent at 220 strip mines, an increase of 3, and 4 percent at 109 auger mines, the same as in 1967. The value of coal mined was $703 million from underground operations, a decrease of 3 percent; $52 million from strip mining; $20 million from auger mining, a decrease of 13 percent.

Table 5.—Coal (bituminous) production

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1964	141,409	$693,572
1965	149,191	726,096
1966	149,681	753,851
1967	153,749	800,683
1968	145,921	775,720

Equipment used at underground mines included 970 cutting machines, 160 fewer than in 1967; 1,052 hand-held and post-mounted drills, a decrease of 363; 241 mobile drills, an increase of 20; 902 rotary drills, a decrease of one; and 277 percussion drills, a decrease of 45.

Strip coal mining equipment included 271 power shovels; 34 draglines, eight carryall scrapers, 324 bulldozers, and 54 horizontal and 103 vertical drills. Transportation of coal from strip pit to tipple, an average distance of 6 miles, was done by 545 trucks. The average capacity of trucks was 20 tons. Equipment at auger mines included 107 augers, 18 power shovels, one dragline, 109 bulldozers, and six horizontal and 10 vertical drills. Coal transportation from auger operation to tipple, an average distance of 7 miles, was done by 230 trucks, with an average truck capacity of 22 tons.

Of the total underground production, mechanically loaded coal increased to 99.9 percent, compared with 98 percent in 1967. Of the total mechanically loaded, 44 percent was by 747 mobile loading machines, 23 less than in 1967. Of the total mobile loading machines, 620 loaded into shuttle cars, and 127 into mine cars or on to conveyors. Continuous mining machines produced 67.8 million tons, equal to 54 percent of the coal mechanically loaded. Of the 612 continuous mining machines in use (51 more than in 1967), 339 loaded into shuttle cars, and 136 into conveyors. An additional 186 mobile loaders were used in conjunction with continuous miners. Of the remainder of the mechanically loaded tonnage, 1 percent was loaded by duckbills, scraper loaders, and hand-loaded face conveyors.

Of the total production, 36 percent was crushed. In 1968, 149 cleaning plants, four fewer than in 1967, cleaned 79 percent of total production, about the same as in 1967. Of this amount, 31 percent was cleaned by jigs, 64 percent by wet washing, and 5 percent by pneumatic methods. Of the total coal cleaned, 31 percent was dried in 55 thermal drying plants and 12 percent was treated for dust control. Of the total treated for dust control, 94 percent was with oil and the balance with calcium chloride and oil and with other materials.

Of the total production, 96 percent was shipped by rail and water and the remainder by truck and other methods. West Virginia Department of Mines reported that the following 44 coal mines employing over 20 men were opened during 1968:

Company	Mine	Address
Addair Coal Company	No. 5	Iaeger.
Backus Mt. Coal Co	No. 1	Layland.
Beards Fork Coal Mng. Corp	No. 5	Beards Fork.
Bethlehem Mines Corp	No. 117	Marfork.
Black Diamond Mng. Co., Inc.	No. 8	Summersville.
Bottom Creek Mng. Corp	No. 6	Raleigh.
Carbon Fuel Company	No. 9–5–21 drift mine	Carbon.
Central Appalachian Coal Co	Coalburg No. 1	Montgomery.
Davis Coal Company	No. 1	Plumley Mt.
Davis Coal Company	No. 2	Layland.
Far North Coal Company	No. 18	Iaeger.
Gauley Coal & Coke Co	Tioga No. 1–A	Richwood.
Gauley Coal & Coke Co	Saxsewell No. 12	Richwood.
Jacks Branch Coal Co	No. 1	Fayetteville.
Karen Coal Company	No. 2	Stephenson.
Layland Coal Co	No. 7	Clintonville.

Company	Mine	Address
Leckie Smokeless Coal Co.	No. 43	Rupert.
Perry-Pocahontas Coal Co.	No. 2	Beaver.
Plumley Mt. Coal Co.	No. 1	Layland.
Plumley Mt. Coal Co.	No. 2	Layland.
Pocahontas Fuel Company	No. 12	Eckman.
Pocahontas Fuel Company	Kebblish mine	Jenkinjones.
Ranger Fuel Corp.	Bolt "D" mine	Bolt.
Reliable Coal Corp.	No. 16-B	Kingwood.
Ridge Mining Co., Inc.	No. 19	Oak Hill.
Riverton Coal Co.	No. 27	Crown Hill.
Robinson Phillips Coal Co.	No. 24	Pineville.
Do	No. 28	Do.
Do	No. 27	Do.
Do	No. 30	Do.
Do	No. 31	Do.
Do	No. 32	Do.
Do	No. 33	Do.
Rose Coal Company, Inc.	No. 4	Ridgeview.
Semet Solvay Div., Allied Chemical Corp.		Montgomery.
Smith Bros. Construction Co.	No. 1	Matewan.
Sparks & Sons Coal Co.	No. 15	Jolo.
Union Carbide Corp.		
Mining & Metals Division	No. 5	Mammoth.
Do	No. 5-B	Do.
United Pocahontas Coal Co.	No. 16	Algoma.
Valley Camp Coal Co.	No. 5-A	Shrewsbury.
Do	No. 30	Do.
Westmoreland Coal Co.	Hampton No. 6	Clothier.
Winding Gulf Coals, Inc.	West Gulf No. 3	Maben.

At the Bureau of Mines Morgantown Coal Research Center, research was continued on improving methods of preparing coal so that it can be utilized more efficiently with minimum air, water, and land pollution. Included were studies on microwave and ultrasonic techniques to reduce the amount of moisture in coal fines; various methods of utilizing radio-active sources for continuous analysis of sulfur in coal; centrifugal, electrostatic, and magnetic methods for removing pyritic sulfur from coal. Rejects of coal mining and washing operations were analyzed for presence of valuable mineral constituents. Research on carbonization, gasification and combustion of coals, especially low-grade coals, was continued. New methods for deriving gasoline, diesel oil, and valuable chemicals from coal tar were investigated, as were methods for carbonizing coal to secure highest product yield and quality with minimum sulfur content. Fluid-bed gasification of coal was investigated, and a gas producer to convert lignite and coking-type bituminous coals into pressurized fuel gas was developed. Various methods of removing hydrogen sulfide from hot producer gas and sulfur dioxide from powerplant stack gasses were also investigated and an apparatus to monitor fly ash and gaseous constitutents of stack gases was being designed and developed. The feasibility of utilizing fly ash for agricultural purposes and as an additive for the manufacture of skid-resistant winter tires was investigated. A high-quality mineral wool exhibiting good corrosion resistance properties was produced from fly ash.

During 1968, the Coal Research Bureau of West Virginia University School of Mines conducted research in areas relating to coal preparation and utilization, and air and water pollution. The research was financed by State of West Virginia appropriations, and by contracts and grants from Federal agencies. Under a contract with Office of Coal Research, U.S. Department of the Interior, an 800-fired-brick-per-day pilot plant was operated during 1968. Production runs on two eight fly ashes selected for pilot plant testing were completed and yields exceeding 95 percent superior quality face bricks were obtained. Application of coal preparation and selective mining techniques and the use of additives to eliminate high-temperature corrosion at coal-fired power plants were investigated.

Consolidation Coal Co., a subsidiary of Continental Oil Co., continued operation of its pilot plant at Cresap, West Virginia for production of gasoline from coal. By the end of the year, the plant made several successful runs. The hydrogenated product was reported to be of a quality suitable for subsequent processing into gasoline by commercial refineries. The pilot plant operation utilized coal from the Pittsburgh seam.

Table 6.—Coal (bituminous) production, by counties

(Thousand short tons and thousand dollars)

County	1967					1968				
	Number of mines			Total production		Number of mines			Total production	
	Underground	Strip	Auger	Quantity	Value	Underground	Strip	Auger	Quantity	Value
Barbour	36	19	2	3,442	$15,521	25	17	3	3,518	$14,872
Boone	49	11	17	9,456	45,163	42	12	19	10,290	51,831
Braxton	1	-----	-----	1	5	2	-----	-----	3	10
Brooke	5	4	1	789	2,827	3	4	1	806	3,051
Clay	6	1	-----	56	250	3	1	-----	W	W
Fayette	77	17	10	5,614	25,370	54	12	9	5,238	24,507
Gilmer	8	1	-----	338	1,535	6	1	-----	100	W
Grant	5	7	-----	W	W	4	7	-----	2,539	11,386
Greenbrier	36	1	-----	635	2,996	33	-----	-----	684	3,632
Hancock	-----	3	-----	33	92	-----	2	-----	W	W
Harrison	22	21	5	7,106	31,725	23	21	2	6,578	29,083
Kanawha	66	6	11	11,551	54,818	57	8	13	11,682	56,706
Lewis	1	4	1	W	W	1	4	1	299	1,185
Logan	62	4	12	17,150	86,454	48	6	11	15,492	80,531
McDowell	201	18	8	17,897	119,198	184	25	9	16,975	116,424
Marion	11	5	-----	15,041	77,081	10	5	2	13,530	70,005
Marshall	4	-----	-----	3,244	14,618	4	-----	-----	3,412	W
Mason	5	1	-----	346	1,556	4	2	1	348	1,240
Mercer	16	7	2	1,693	10,961	17	3	2	1,317	9,013
Mineral	3	3	2	159	661	3	2	-----	162	659
Mingo	51	1	7	5,271	28,593	52	3	8	4,637	24,539
Monongalia	31	9	2	10,470	48,489	27	9	1	10,228	48,688
Nicholas	81	6	2	8,329	45,098	64	10	3	7,392	41,512
Ohio	2	-----	-----	W	W	2	-----	1	W	W
Pocahontas	8	-----	1	149	576	9	-----	-----	134	538
Preston	57	17	2	2,794	9,734	43	17	-----	2,245	8,456
Raleigh	69	16	6	8,611	51,978	62	23	8	8,540	52,381
Randolph	17	6	1	561	2,206	15	5	2	510	2,099
Taylor	11	5	-----	180	695	9	5	-----	119	453
Tucker	-----	3	-----	575	W	-----	1	-----	480	W
Upshur	8	10	3	671	2,585	8	8	1	556	1,901
Wayne	1	-----	-----	31	W	2	-----	-----	32	W
Webster	20	5	2	468	2,089	14	5	2	277	1,004
Wyoming	100	6	12	15,894	93,444	104	2	10	15,023	89,659
Undistributed	-----	-----	-----	5,194	24,365	-----	-----	-----	2,775	30,355
Total	1,070	217	109	153,749	800,683	934	220	109	145,921	775,720

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Natural Gas Liquids.—Production of natural gas liquids in 1968 increased. Reserves of all natural gas liquids at yearend 1968 were 84 million (42-gallon) barrels, 2 million barrels more than in 1967.[2] There were 34 natural gas processing plants, including 26 small compression plants operated by Pennzoil United, Inc.

Petroleum and Natural Gas.—Crude oil production in 1968 was 3.3 million barrels, a decrease of 7 percent from that of 1967.[3] The wellhead price was reduced to $3.97 per barrel from $4 per barrel in 1967. The wellhead price of gas ranged from $0.25 to $0.28 per 1,000 cubic feet. Natural gas production of 236,971 million cubic feet was 12.1 percent more than in 1967. The estimated number of producing wells in the State at yearend 1968 was 18,214 gas wells and 13,049 oil wells.

There was a slight decline in oil and gas drilling in the State in 1968. Drilling was reported in 42 of the State's 55 counties. According to the Oil and Gas Division, West Virginia State Department of Mines, during 1968 the State issued 912 permits to drill, deepen, and fracture wells compared with 975 permits issued in 1967. Total footage drilled was 2,432,394 feet, compared with 2,148,391 feet in 1967. There were 2,016,933 feet of development drilling and 415,461 feet of exploratory tests. The average depth of the wells drilled was 3,022 feet. A total of 805 wells were drilled in 1968, 43 less than in 1967. Of these, 536 were gas wells, 88 oil wells, 95 dry holes, 69 combination wells, and 17 were miscellaneous wells (storage, injection, etc.). A decline in drilling of oil wells from 206 in 1967 to 88 in 1968 was the major factor leading to a decrease in 1968 well totals. There were 91 exploratory wells of which 47 were successful—42 gas wells, two oil wells, and three combination oil and gas producers.

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[2] American Gas Association. Report of the Committee on Natural Gas Reserves. Apr. 7, 1969, table 2.

[3] West Virginia Geological and Economic Survey.

According to American Gas Association, at yearend 1968 the State had ultimate gas storage capacity of 385,341 billion cubic feet. The two refineries in the State located near Falling Rock and St. Marys, having a combined refining capacity of 8,800 barrels per schedule day of crude oil, refined most of the crude oil produced in the State. The refineries produced gasoline, lubricating oil and waxes. According to the West Virginia Geological and Economic Survey the cutback in purchases of Pennsylvania grade crude, combined with price reduction during 1968 resulted in a sharp decline in oil well completions and a decrease in production.

According to Oil and Gas Journal, estimated proved reserves of crude oil at yearend were 53.6 million barrels, a decrease of 2.6 million barrels from 1967 reserves. Reserves of natural gas at the end of 1968 were 2,586 billion cubic feet, about the same as in 1967.

The important discovery of commercial quality gas in the Tuscarora Sandstone and the discovery of the first commercial Silurian oil production (Newburg) in the State were of special interest. For the second consecutive year, Newburg (Williamsport Sandstone) exploration and development was the principal deep target in the State. Rocky Fork (Kanawha and Putnam Counties) became the largest active gasfield. The field covered an area of 30 square miles and contained 96 completed gas wells averaging 5,700 feet in depth. Kanawha Forest (Boone and Kanawha Counties), the oldest and the second largest of the Newburg gasfields, reported seven completions consisting of five gas and two dry holes. Fourteen gas wells were reported completed in South Burns Chapel (Monongalia and Preston Counties), the largest active Huntersville Chert-Oriskany Sandstone field in the State. The Atlantic-Inland Oil Corporation discovered the Wheaton Run field in Jackson County, the first commercial Silurian oil production in the State. It produced 300 barrels per day of treated oil from the Newburg. Shallow drilling resulted in the discovery of one new field, one new pool, five deeper pools, three shallower pools, and 14 extensions. The Big Injun continued to be the primary objective of shallow drilling during 1968. Although, as in previous years, the largest number of oil and gas wells were drilled in Big Injun sand (Middle Mississippian) the number of completed wells dropped sharply to 291 from 416 wells in 1967. Of these, 160 were gas wells, 71 oil wells, 45 combination, and 12 dry.

NONMETALS

Cement.—Shipments of portland cement decreased 6 percent and masonry cement decreased 8 percent from the 1967 level. The average price per barrel was slightly higher. The sole producer, Capitol Cement Co., Division Martin Marietta Corp., at Martinsburg, Berkeley County, operated three coal-fired rotary kilns. Most of the cement was used for ready-mix concrete, concrete products, and building and highway construction. Shipments were to Delaware, District of Columbia, Maryland, North Carolina, Ohio, Western Pennsylvania, Virginia, and West Virginia. Two-thirds of the cement was shipped by truck and one-third by railroad.

Clays.—Production of miscellaneous clay declined 51,211 tons. Miscellaneous clay was chiefly used in the manufacture of cement and building brick. Fire clay was mostly used for producing firebrick and block. Thirteen mines were in operation, the same as in 1967. Nine of the mines were open pit and four were underground operations. Highest production of miscellaneous clay was from Berkeley County.

Gem Stones.—Hobbyists collected mineral specimens at scattered locations. Quartz specimens and various cherts were collected from bedrock exposures. Chert, quartz, and granite, and the harder varieties of gravel were collected from Ohio River Valley terraces.

Lime.—Total lime production was 207,410 tons compared with 217,000 tons in 1967. Chief uses were for steel production, refractory lime, and for pulp and paper manufacture. Three companies operated plants—one each in Berkeley, Jefferson, and Pendleton Counties.

Salt.—Production of salt from brines was 16 percent higher than in 1967. Most of it was used by the producers for manufacture of chlorine and caustic soda. Production, reported from Marshall, Pleasants, and Tyler Counties, was from deep well solution mining.

Sand and Gravel.—Output of sand and gravel decreased 3 percent in quantity and total value decreased 2 percent from that of 1967. The average price increased by $0.01 to $2.10. Of the total output, 59 percent was sand and 41 percent was gravel. About 64 percent of the output was shipped by barge and the balance was shipped by railroad and truck.

Production was reported from 13 counties. Of the leading producing counties, Morgan was first in value, followed in descending order by Hancock, Wood, Pleasants, Monroe, Brooke, Ohio, and Wetzel Counties. The sand and gravel was produced by nine stationary plants, two portable plants, and six dredges.

Slag.—Weirton Steel Division, National Steel Corp. produced air-cooled crushed blast furnace slag for aggregate use.

Stone.—Total crushed stone production (limestone and sandstone) decreased by 5 percent from that of 1967, although output of crushed limestone increased slightly to 8 million tons. Major uses for the limestone were concrete aggregate and road metal, as flux in iron and steel production, railroad ballast, agriculture, and lime and cement manufacture. Berkeley, Jefferson, Monongalia, and Greenbrier Counties were the leading areas of limestone production.

Production of crushed sandstone which was mostly used for concrete aggregate

Table 7.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,674	$2,142	1,717	$2,258
Paving	478	782	482	781
Fire or furnace	W	W	34	43
Gravel:				
Building	1,500	1,880	1,372	1,808
Paving	909	1,411	894	1,409
Undistributed [1]	1,266	5,952	1,158	5,601
Total sand and gravel	5,827	12,167	5,657	11,900

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes glass, molding, blast, fill, engine, filtration, ground and other industrial sands; railroad ballast and fill gravel and items indicated by symbol W.

Table 8.—Stone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1967		1968	
	Quantity	Value	Quantity	Value
Crushed and broken stone:				
Aggregates [1]	3,952	$6,675	3,570	$6,556
Railroad ballast	563	594	588	739
Agriculture	131	327	127	311
Other uses [2]	4,800	8,850	4,726	9,183
Total [3]	9,445	16,447	9,011	16,789

[1] Includes concrete, bituminous, macadam, surface treatment aggregates, and dense graded road base stone.

[2] Includes limestone for glass (1967), paper (1967), asphalt filler (1967), coal dust, filter stone, stone sand, cement, lime, riprap, flux, refractory materials, and miscellaneous uses; sandstone for traction grit (1968), stone sand, and refractory use.

[3] Data may not add to totals because of independent rounding.

and highway construction decreased to 1,062,521 tons valued at $2.5 million from 1,590,257 valued at $2.9 million in 1967. Leading sandstone producing counties were Kanawha, Doddridge, Monongalia, Marion, Lewis, Raleigh, Brooke, Harrison, and Wood Counties.

METALS

Aluminum.—The aluminum works of Kaiser Aluminum & Chemical Corp. at Ravenswood, Jackson County, operated at full capacity during 1968. Alumina for the plant was obtained from the company's facilities at Baton Rouge and Gramercy, La. The bauxite for the alumina manufacture was imported from company owned and operated bauxite mines in Jamaica. The alumina was transported to Ravenswood by unit trainloads. Aluminum fluoride for the electrolytic cells was obtained from the company-owned plant in Gramercy, La.; fluorspar for the manufacture of aluminum fluoride was imported from Mexico. Carbon electrodes were manufactured at Ravenswood from the calcined petroleum coke produced at Kaiser's calcining facilities at Gary, Ind., and Norco, La. Electric power for the plant was purchased from the American Electric Power Company's coal fired power plant at Philipsform, W. Va. During 1968, the plant had 3,400 employees. Each of the four potlines was operating at its monthly capacity of 7 million pounds of aluminum. The aluminum was rolled into 36 million pounds of sheet, plate, and foil products consisting of pure aluminum and alloys containing manganese, magnesium, zinc, and copper. The $55 million expansion program initiated in 1967 was continued during 1968.

Ferroalloys.—Foote Mineral Corporation's ferroalloy plant at Alloy, Fayette County, operated a total of five electric arc furnaces. During 1968, the company started the manufacture of a new ferrovanadium alloy from vanadiferous slag imported from the Republic of South Africa. This new alloy which the company has named SOLVAN consists of 25 to 30 percent vanadium, 3 to 5 percent silicon, 0.10 percent carbon, 3.8 percent manganese, 2.8 percent chromium, 1.25 percent nickel, 1.5 to 2 percent titanium, and the balance iron. The ferroalloy plant operated at full capacity. The company manufactured ferrovanadium, ferrochromium, ferrosilicon, foundry alloys, nodular iron alloy, and 98-percent-pure silicon metal. Raw materials consumed included quartzite of 99-percent silica content, high-grade ferroalloy quality chrome and manganese ores, and mild-steel machine shop turnings. All coal consumed by the company was obtained from mines in West Virginia and coke was obtained from the Pittsburgh district in Pennsylvania. Union Carbide Corporation's large ferroalloy plant at Alloy, Fayette County, also operated at full capacity. During 1968, the company completed the installation of a new 20,000-kilovolt-ampere (kva), three-phase submerged arc electric furnace for the manufacture of ferromanganese. Most mineral materials consumed were obtained from other States or imported. As in previous years, the company obtained 20 percent of its total quartzite from a leased property within 20 miles of the plant. The quartzite assayed 85 percent silica. High-grade quartzite of 99 percent silica content was secured from North Carolina. The company-owned mines in the vicinity supplied 50 percent of the coal requirements; the remainder was purchased. In 1968, larger quantities of ferroalloys were transported by controlled flow dump truck than in the previous year. This method of transportation reduces the delivered cost when compared with that of shipment in boxes. Of the finished products, 20 percent was shipped by barge, 40 percent by rail, and 40 percent by truck.

Nickel.—The Huntington Alloy Products Division, International Nickel Company, Inc., rolled various types of high-nickel alloys at its Huntington operations. The plant produced nickel and high-nickel alloys in mill forms such as strip, sheet, plate, pipe, tube, wire, rod, bar, and welding products such as nickel and high-nickel bare welding filler wire, coated electrodes, and welding fluxes. Nickel and electrolytic copper in the form of cathodes and scrap were obtained from Canada and the United States, and aluminum, ferrochrome, ferrosilicon, and silicon metal from West Virginia. During 1968, the plant modernization program was continued.

Zinc.—Mathiessen & Hegeler Zinc Co. refined zinc in 20 vertical zinc retorts at their plant at Meadowbrook, West Virginia. The raw materials were precalcined zinc sulfide concentrates imported from Canada and from zinc dross. Coal for the operation was obtained locally. Clay was obtained from Ohio, anthracite from Pennsylvania, and waste sulfide liquor from Michigan. The plant produced zinc slabs, dust, and ball anodes.

Zirconium.—Specialty Metals Division of American Metals Climax, Inc., produced zirconium sponge from zircon sand at their plant in Washington, W. Va. Imported zircon from Australia was converted to zirconium carbonitride in a 5,000-kva arc-type electric furnace. Zirconium tetrachloride was prepared from the carbonitride by direct chlorination in fixed bed water-cooled exothermic chlorinators. The zirconium tetrachloride is processed to remove the small quantities of hafnium contained in the tetrachloride by selective solvent extraction. The purified zirconium tetrachloride was reduced to sponge zirconium with metallic magnesium and shipped to the company's plant in Akron, N.Y., for conversion into ingots and rolling the ingots into various shapes.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Cement (portland and masonry):			
Capitol Cement Co., Div., of Martin Marietta Corp.[1]	Box 5618 Baltimore, Md. 21210	Plant	Berkeley.
Clays:			
Fire clay:			
Charleston Brick & Tile Corp.	P.O. Box 207 Charleston, W.Va. 25322	Underground	Kanawha.
Crescent Brick Co., Inc.	Box 368 New Cumberland, W.Va 26047	do	Hancock.
Globe Refractories, Inc.	P.O. Box D Newell, W.Va 26050	do	Do.
West Virginia Brick Co.	442 Virginia St., East Charleston, W.Va. 25300	do	Kanawha.
Miscellaneous clay and shale:			
Barboursville Clay Mfg. Co.	P.O. Box 1048 Charleston, W.Va. 25324	Pit	Cabell.
Continental Clay Products Co.	931 Investment Bldg. 15th & K Sts., N.W. Washington, D.C. 20005	Pit	Berkeley.
Grafton Brick Co.	1012 Grant Bldg. Pittsburgh, Pa. 15219	Pit	Taylor.
Gum Bros.	795 W. 2d St. Weston, W.Va. 26452	Pit	Lewis.
Lincoln Clay Product Co.	West Hamlin, W.Va. 25571	Pit	Lincoln.
Sanders Dummy Co.	Midkiff, W.Va. 25540	Pit	Do.
The United Clay Products Co.	931 Investment Bldg. Washington, D.C. 20005	Pit	Berkeley.
Virginia Brick & Tile Co.	P.O. Box 983 Princeton, W.Va. 24740	Pit	Mercer.
Coal (bituminous):			
Amherst Coal Company [2]	Lundale, W.Va. 25631	Underground	Logan.
Armco Steel Corp.[3]	Montcoal, W.Va. 25135	do	Boone.
Bethlehem Mines Corp.[3] [4]	701 E. 3d St. Bethlehem, Pa. 18015	do	Marion.
Bishop Coal Co.	Pocahontas, Va. 24635	do	McDowell.
Cannelton Coal Co.[5]	Cannelton, W.Va. 25036	do	Kanawha.
Christopher Coal Co., Div. of Consolidation Coal Co.[5]	P.O. Box 100 Osage, W.Va. 26543	do	Monongalia.
Clinchfield Coal Co.[6]	P.O. Box 472 Clarksburg, W.Va. 26301	do	Harrison.
Eastern Associated Coal Corp.	Koppers Bldg. Pittsburgh, Pa. 15219	do	Boone and Wyoming
Eastern Associated Coal Corp.		do	Marion and McDowell.
Gauley Coal & Coke Co.[7]	Box 191 Richwood, W.Va. 26685	do	Nicholas.
Island Creek Coal Co.[7]	Holden, W.Va. 25625	do	Logan.
Do.[6]	do	do	Mingo.
Do.[4]	do	do	Wyoming.
Itmann Coal Co.	Pocahontas, Va. 24635	do	Do.
Mountaineer Coal Co., Div. of Consolidation Coal Co.[6]	Box 1632 Fairmont, W. Va. 26555	do	Harrison.
Do.[5]		do	Marion.
National Coal Mining Company	Drawer L Holden, W.Va. 25625	do	Mingo.
Ohio Valley Division Consolidation Coal Co.[4]	Moundsville, W.Va. 26041	do	Marshall.

See footnotes at end of table.

Table 9.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal (bituminous)—Continued			
Olga Coal Co.[3]	P.O. Box 900 Youngstown, Ohio 44500	Underground	McDowell.
Pocahontas Fuel Co., Div. of Consolidation Coal Co.[5]	Pocahontas, Va. 24635	do	Do.
Do.[4]		do	Mercer.
Rochester & Pittsburgh Coal Co.	655 Church St. Indiana, Pa. 15701	do	Marion.
Slab Fork Coal Co	Slab Fork, W.Va. 25920	do	Raleigh.
The Carbon Fuel Co.[6]	1310 Kanawha Valley Bldg. Charleston, W.Va. 25300	do	Kanawha.
The Valley Camp Coal Co.[7]	2971 Dupont Ave. Shrewsbury, W.Va. 25184	do	Do.
Do.[4]	P.O. Box 218 Triadelphia, W.Va. 26059	do	Ohio.
Union Carbide Corp.[3] [6]	Box 38 Mammoth, W.Va. 25132	do	Kanawha.
United States Steel Corp.[3] [8]	525 William Penn Place Pittsburgh, Pa. 15219	do	McDowell.
Westmoreland Coal Co.[3]	123 S. Broad St. Philadelphia, Pa. 19109	do	Boone.
Lime:			
Germany Valley Limestone Co. Div. of Greer Limestone Co.[9]	Riverton, W. Va. 26814	Plant	Pendleton.
Jones & Laughlin Steel Corp., Blair Limestone Div.[10]	R.D. 3 Martinsburg, W.Va. 25401	do	Berkeley.
Standard Lime & Refractories Div. Martin Marietta Corp.[9]	2000 First National Bank Bldg. Baltimore, Md. 21203	do	Jefferson.
Magnesium compounds: Amax Specialty Metals, Inc.	P.O. Box 1728 Parkersburg, W.Va.26101	do	Wood.
Petroleum refineries:			
Elk Refining Company	Falling Rock, W.Va. 25079	do	Kanawha.
Quaker State Oil Refining Corp	St. Marys, W.Va. 26170	do	Pleasants.
Salt:			
Industrial Chemicals Div., Allied Chemical Corp.	P.O. Box 70 Morristown, N.J. 07960	do	Marshall.
Inorganic Chemical Div. FMC Corp.	Box 8127 South Charleston W.Va. 25303	Mine	Tyler and Pleasants.
PPG Industries, Inc., Chemical Div.	1 Gateway Center Pittsburgh, Pa. 15222	Plant	Marshall.
Sand and gravel:			
Delta Concrete Co	41st & Noble Sts. Bellaire, Ohio 43906	Pit	Ohio.
Dravo Corp., Keystone Div	Fifth & Liberty Avenues Pittsburgh, Pa. 15222	Dredge	Hancock.
Duquesne Sand Co	East Beaver St. Glenfield, Pa. 15115	do	Brooke.
Iron City Sand & Gravel Corp., Division of McDonough Co.	P.O. Box 538 Parkersburg, W.Va. 26100	Pit	Hancock.
Kanawha Sand Co	Box 607 Parkersburg, W.Va. 26100	Dredge	Wood.
Ohio River Sand & Gravel, Division of McDonough Co.	P.O. Box 538 Parkersburg, W.Va. 26100	do	Monroe, Pleasants, Wood.
Ohio Valley Sand Co., Inc	P.O. Box 99 New Martinsville, W.Va. 26155	Pit	Wetzel.
Pennsylvania Glass Sand Corp	Berkeley Springs, W.Va. 25411	Pit	Morgan.
Pfaff & Smith Builders Supply Co.	P.O. Box 2508 Charleston, W.Va. 25329	Dredge	Wood.
Smelters:			
Kaiser Aluminum & Chemical Corp.	300 Lakeside Drive Oakland, Calif. 94626	Plant	Jackson.
Mathiessen & Hegler Zinc Co	Ninth & Sterling Sts. La Salle, Ill. 61301	do	Harrison.
Stone:			
Limestone (crushed):			
Acme Limestone Co	Fort Spring, W.Va. 24936	Mine and quarry.	Greenbrier.
Aurora Stone Co., Inc	Route 3 Keyser, W.Va. 26726	Quarry	Mineral.
Appalachian Stone Div., Martin Marietta Corp.	Box 120 Mercersburg, Pa. 17236	do	Berkeley.
R. H. Burns Co., Inc	Hillsboro, W.Va. 24946	do	Pocahontas.
Elkins Limestone Co.[11]	Elkins, W.Va. 26241	Mine	Randolph.
The H. Frazier Co., Inc	P.O. Box 1377 Richmond, Va. 23211	Quarry	Greenbrier.
Green Bag Cement Co. Div. of Marquette Cement Mfg. Co.	20 N. Wacker Drive Chicago, Ill. 60606	Mine	Monongalia.

See footnotes at end of table.

Table 9.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone (crushed)—Continued			
Greer Limestone Co.[12]	Greer Building Morgantown, W.Va. 26505	Mine and quarry.	Monongalia.
Jones & Laughlin Steel Corp., Blair Limestone Division.	R.D. 3 Martinsburg, W.Va. 25401	Quarry	Jefferson.
Terra Alta Limestone Co.	Aurora, W.Va. 26705	do	Pocahontas and Preston.
United States Steel Corp.	Millville, W.Va. 25432	do	Jefferson.
Sandstone (dimension):			
Rhine Creek Stone Co.	Box 265 Eglon, W.Va. 26716	do	Preston.
Sandstone (crushed):			
Fairfax Sand & Crushed Stone Co.	Thomas, W.Va. 26292	do	Tucker.
Basil R. Heavner	French Creek, W.Va. 26218	do	Lewis.
Mazzella Quarries, Inc.	2087 Oakridge Dr. Charleston, W.Va. 25311	do	Kanawha.
Meadows Stone & Paving, Inc.	P.O. Box 518 Gassway, W.Va. 26624	do	Braxton and Nicholas.
Raleigh Stone Co. of Beckley, West Va.	P.O. Box 1387 Roanoke, Va. 24001	do	Raleigh.
Salerno Brothers, Inc.	Shinnston, W.Va. 26431	do	Harrison.
Terra Alta Limestone Co.	Aurora, W.Va. 26705	do	Doddridge and Harrison.
Tony Pacifico Stone Quarry, Inc.	1417 Camden Drive Charleston, W.Va. 25302	do	Kanawha.

[1] Also limestone and shale. [2] 6 mines. [3] Captive. [4] 2 mines. [5] 4 mines. [6] 3 mines. [7] 5 mines. [8] 7 mines. [9] Also limestone. [10] Also limestone and dolomite. [11] Also crushed sandstone. [12] Also quartzite.

The Mineral Industry of Wisconsin

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Wisconsin Geological Survey for collecting information on all minerals except fuels.

By Keith S. Olson[1]

Value of Wisconsin's 1968 mineral output declined 10 percent from the record high set in 1967 to $71.7 million, mainly because of significant decreases in the value of cement, sand and gravel, and zinc production. Nonmetals, comprising about 90 percent of the total value, decreased about 9 percent from that of 1967. Production of metals (lead and zinc), representing 10 percent of the total mineral value, declined 14 percent. Quantity and value decreases occurred in the output of cement, clays, lead, sand and gravel, and zinc. Production of abrasive stone, lime, and peat registered increases in both quantity and value. Stone production decreased in quantity but increased in value. Higher unit values were reported for all nonmetals except abrasive stone.

Mineral production was reported from 71 of the State's 72 counties, led by Waukesha, Lafayette, Milwaukee, Marathon, and Dane, in descending order of value. Collectively, these counties represented about 36 percent of the State total. Value of mineral production exceeded $1 million in 18 counties compared with 20 counties in 1967.

Despite the decrease in value of mineral output in 1968, the future for mineral production in Wisconsin looks brighter with development of a taconite operation at Black River Falls by Jackson County Iron Co., a subsidiary of Inland Steel Co.,

Table 1.—Mineral production in Wisconsin[1]

Mineral	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays .... thousand short tons..	89	$112	17	$84
Lead (recoverable content of ores, etc.) .... short tons..	1,596	447	1,126	298
Lime .... thousand short tons..	212	3,414	224	3,620
Peat .... short tons..	1,823	W	1,902	153
Sand and gravel .... thousand short tons..	42,542	32,955	39,807	30,903
Stone .... do....	17,122	24,863	17,000	25,223
Zinc (recoverable content of ores, etc.) .... short tons..	28,953	8,016	25,711	6,942
Value of items that cannot be disclosed: Abrasive stone (grinding pebbles), cement, gem stones, and value indicated by symbol W	XX	9,805	XX	4,522
Total	XX	79,612	XX	71,695
Total 1957–59 constant dollars	XX	75,209	XX	p 67,097

p Preliminary. XX Not applicable.

W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

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[1] Industry economist, Bureau of Mines, Minneapolis, Minn.

and the production of white cement at Manitowoc by Medusa Portland Cement Co. Both operations were scheduled to begin production in 1969.

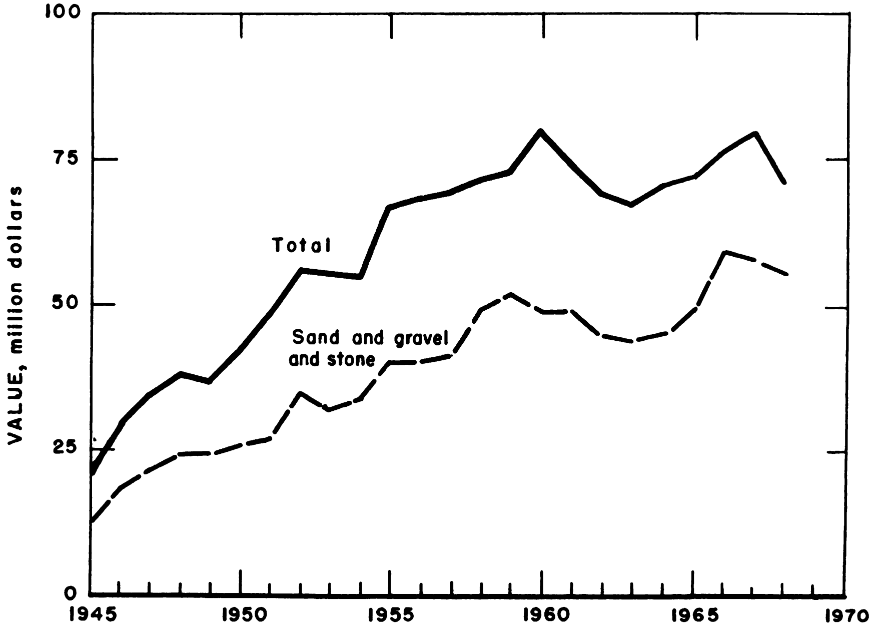

Figure 1.—Value of sand and gravel, stone, and total value of mineral production in Wisconsin.

Table 2.—Value of mineral production in Wisconsin, by counties[1]

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Adams	W	W	Sand and gravel.
Ashland	$347	$166	Sand and gravel, stone.
Barron	450	356	Sand and gravel.
Bayfield	93	179	Do.
Brown	1,235	1,444	Stone, sand and gravel, lime.
Buffalo	295	251	Stone, sand and gravel.
Burnett	143	133	Sand and gravel, stone.
Calumet	256	381	Stone, sand and gravel.
Chippewa	194	W	Sand and gravel.
Clark	531	W	Sand and gravel, stone.
Columbia	W	W	Do.
Crawford	558	294	Stone, sand and gravel.
Dane	3,200	3,168	Sand and gravel, stone.
Dodge	1,701	1,776	Lime, stone, sand and gravel.
Door	332	343	Sand and gravel, stone.
Douglas	W	W	Lime, sand and gravel.
Dunn	142	344	Stone, sand and gravel, clays.
Eau Claire	1,497	W	Sand and gravel.
Florence	W	46	Do.
Fond du Lac	1,684	1,392	Stone, sand and gravel, lime, clays.
Forest	85	112	Sand and gravel.
Grant	3,122	3,001	Zinc, stone, sand and gravel, lead.
Green	467	W	Stone, sand and gravel.
Green Lake	570	540	Sand and gravel, stone.
Iowa	829	420	Stone, zinc, lead.
Iron	W	25	Sand and gravel.
Jackson	632	714	Do.
Jefferson	191	207	Sand and gravel, stone.
Juneau	W	W	Stone, sand and gravel.
Kenosha	66	285	Sand and gravel.
Kewaunee	516	451	Do.
La Crosse	W	540	Stone, sand and gravel.
Lafayette	W	5,586	Zinc, stone, lead.
Langlade	354	425	Sand and gravel.
Lincoln	343	359	Sand and gravel, peat.
Manitowoc	W	1,492	Sand and gravel, lime, stone, cement.
Marathon	3,760	3,762	Stone, sand and gravel.
Marinette	W	W	Do.
Marquette	238	W	Do.
Milwaukee	W	W	Cement, stone, sand and gravel.
Monroe	338	359	Stone, sand and gravel.
Oconto	477	420	Sand and gravel, stone.
Oneida	313	150	Sand and gravel.
Outagamie	606	652	Stone, sand and gravel.
Ozaukee	934	633	Sand and gravel.
Pepin	84	67	Sand and gravel, stone.
Pierce	355	314	Stone, sand and gravel, clays.
Polk	1,047	859	Stone, sand and gravel.
Portage	527	559	Sand and gravel.
Price	97	W	Do.
Racine	1,716	1,290	Stone, sand and gravel, clays.
Richland	W	352	Stone, sand and gravel.
Rock	2,463	2,302	Sand and gravel, stone.
Rusk	226	144	Sand and gravel.
St. Croix	467	548	Stone, sand and gravel.
Sauk	1,758	1,711	Stone, sand and gravel, abrasives.
Sawyer	146	92	Sand and gravel.
Shawano	287	240	Sand and gravel, stone.
Sheboygan	705	585	Do.
Taylor	460	426	Sand and gravel.
Trempealeau	148	126	Stone, sand and gravel.
Vernon	W	313	Do.
Vilas	135	202	Sand and gravel.
Walworth	855	897	Do.
Washburn	78	W	Do.
Washington	1,692	1,333	Do.
Waukesha	8,296	7,670	Sand and gravel, stone, peat.
Waupaca	366	336	Sand and gravel, stone.
Waushara	103	93	Sand and gravel.
Winnebago	2,571	2,123	Stone, sand and gravel.
Wood	482	296	Sand and gravel, stone.
Undistributed[2]	28,057	18,405	Do.
Total[3]	79,612	71,695	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] No production reported for Menominee County.

[2] Includes some sand and gravel and stone that cannot be assigned to specific counties, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Wisconsin business activity

	1967	1968	Change (percent)
Employment and labor force, annual average:[1]			
Total labor force……thousands..	^{r}1,812.8	1,846.7	+1.9
Agricultural employment……do….	167.2	170.4	+1.9
Nonagricultural employment [2]……do….	^{r}1,576.9	1,609.6	+2.1
Manufacturing……do….	^{r}508.7	507.6	−.2
Construction……do….	^{r}64.1	66.0	+3.0
Mining and quarrying……do….	^{r}2.6	2.5	−3.8
Stone, clay, and glass products……do….	^{r}7.5	7.2	−4.0
Primary metal industries……do….	30.6	29.7	−2.9
All other……do….	1,001.5	1,033.5	+3.2
Manufacturing payrolls [3]……millions..	$3,587.2	$3,796.6	+5.8
Personal income:			
Total……do….	$13,220	^{p}$14,382	+8.8
Per capita……	$3,152	^{p}$3,407	+8.1
Construction activity:			
Building permits:[4]			
Valuation of authorized residential construction….millions..	$341.4	$355.2	+4.0
Number of private and public residential building units authorized……	24,131	25,010	+3.6
Contract construction work performed:			
Total……millions..	^{r}$1,116	$1,252	+12.2
Nonresidential building……do….	$450	$553	+22.9
Residential building……do….	^{r}$406	$493	+21.4
Nonbuilding……do….	$261	$206	−21.1
State highway commission contracts awarded……do….	$105.8	$85.2	−19.5
Portland cement shipments to and within Wisconsin thousand 376-pound barrels..	10,000	8,967	−10.3
Retail sales……millions..	$6,664	$7,123	+6.9
Farm marketing receipts……do….	^{r}$1,403	^{p}$1,459	+4.0
Mineral production……do….	$79.6	$71.7	−9.9
Utility production and consumption:			
Production of electric energy by electric utilities million kilowatt hours..	21,487	^{p}22,911	+6.6
Natural gas consumption……million cubic feet..	248,033	271,765	+9.6
International trade:[5]			
Value of exports through Wisconsin……millions..	$96.4	$132.9	+37.9
Value of imports through Wisconsin……do….	$99.0	$116.0	+17.2

^{p} Preliminary. ^{r} Revised.

[1] Adjusted to March 1968 benchmark levels.

[2] Includes nonagricultural wage and salary, self-employed, unpaid family workers, and domestic workers in private households.

[3] Includes workers covered under the Wisconsin Employment Security Law.

[4] Based on a Nationwide universe of 13,000 permit issuing places.

[5] Includes Milwaukee, Wis., Customs District.

Sources: Wisconsin Department of Industry, Labor, and Human Relations in cooperation with the U.S. Department of Labor, Survey of Current Business, Construction Reports, Statistical Abstract of the United States, Wisconsin Department of Transportation, Sales Management, Farm Income Situation, Federal Power Commission, and U. S. Department of Commerce.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Peat……	12	159	2	15	-------	1	67.97	476
Metal……	218	279	59	475	-------	36	75.79	1,501
Nonmetal……	107	108	12	97	-------	1	10.31	24,742
Sand and gravel……	2,009	202	407	3,589	3	69	20.06	5,358
Stone……	1,950	215	420	3,518	2	99	23.75	4,522
Total……	4,291	210	900	7,689	5	206	27.44	4,973
1968:^{p}								
Peat……	10	226	2	18	-------	-------	-------	-------
Metal……	215	223	49	394	-------	21	58.36	2,866
Nonmetal……	100	112	11	93	-------	1	10.80	108
Sand and gravel……	2,055	199	409	3,572	-------	73	20.43	736
Stone……	1,880	213	401	3,409	1	81	24.12	2,541
Total [1]……	4,260	204	373	7,477	1	176	23.67	1,659

^{p} Preliminary. [1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Stone.—Baraboo Quartzite Co., Inc., produced grinding pebbles from a quartzite deposit near Baraboo. Output increased in both quantity and value over that of 1967.

Cement.—Output of portland cement declined sharply from that of the previous year due to the cessation of cement manufacturing in late 1967 by the Manitowoc Portland Cement Co., a subsidiary of Medusa Portland Cement Co., at Manitowoc. The parent company neared completion of its program to convert the Manitowoc plant to white cement production, with the plant scheduled to reopen in the spring of 1969. The State's only producing cement plant, operated by Marquette Cement Manufacturing Co. in Milwaukee, produced types I and II (general use and moderate heat) and type III (high-early-strength) portland cement and masonry cement. Most of the output was shipped in bulk, by truck. Lesser shipments were made in bags by truck and rail, and in bulk form by rail. Most of the State's portland cement production was shipped to ready-mixed concrete companies; lesser amounts were consumed by cement product manufacturers and building material dealers. Shipments of masonry cement increased 2 percent in quantity and 5 percent in value over that of 1967.

Nearly all the cement produced in Wisconsin was shipped to points within the State. In addition, shipments were received from plants in nine other States. Total shipments of cement into and within Wisconsin were nearly 9 million barrels of portland cement and nearly 500,000 barrels of masonry cement.

Clays.—Production of clay and shale decreased markedly from that of 1967 mainly because of the discontinuance of cement manufacturing by Manitowoc Portland Cement Co. In recent years, that company was the leading producer of clay in Wisconsin. Production was reported by three companies operating pits in Dunn, Fond du Lac, and Racine Counties. Material was used for making building brick and other heavy clay products. In addition, stockpiled clay mined in previous years from Pierce County was used in the manufacture of vitrified sewer pipe in Minnesota. The entire output of clay and shale was consumed by the producing companies. In May, the Menomonie Brick Co. at Menomonie was sold to Twin City Brick Co. of St. Paul, Minn. The name of the Menomonie operation was changed to Red Cedar Brick Co., Inc.

The Wisconsin Geological Survey studied the industrial potential of certain Wisconsin clays. Clays from various locations in west-central Wisconsin were analyzed.

Lime.—Wisconsin lime production increased 6 percent in quantity and value from that of 1967. Production of quicklime, which comprised about two-thirds of Wisconsin's lime output, increased 2 percent in quantity and 3 percent in value. Output of hydrated lime increased 13 percent in quantity and 11 percent in value. Three companies operated five lime plants in Brown, Dodge, Douglas, Fond du Lac, and Manitowoc Counties. Cutler-LaLiberte-McDougall Corp. produced quicklime and hydrated lime at its plant in Superior. Facilities for producing hydrated lime at this plant were completed during the year. The Western Lime & Cement Co. produced quicklime and hydrated lime at Eden and Green Bay and hydrated lime at its Knowles plant. Rockwell Lime Co. produced quicklime and hydrated lime near Manitowoc. Mayville White Lime Works in Dodge County did not produce quicklime in 1968.

About 68 percent of the total output was used for chemical and other industrial uses. Principal uses, in decreasing order of tonnage, included paper manufacture, water purification, sewage disposal, steelmaking, copper ore concentration, abrasives, food processing, tanning, petroleum refining, insecticides, metallurgy, plastics, and brickmaking. Over 31 percent of the State lime output was used for construction purposes, including mason's lime and soil stabilization. The remainder was used for agricultural purposes. Nearly 37 percent of the State 1968 lime production was shipped to Wisconsin consumers. The remainder went to 13 other States and to Canada. Principal out-of-State shipments were to Illinois and Minnesota.

Perlite.—Expanded perlite was produced at Milwaukee and Appleton from crude material mined outside the State. Material was used for lightweight aggregate in concrete, tile, and building plaster; loose fill insulation; soil conditioning; additive in paint; foundry purposes; and textured granules. Production decreased in quantity and value from that of 1967.

Sand and Gravel.—Sand and gravel ranked first among the mineral commodities in value of output and accounted for 43 percent of the State's mineral value. However, because of labor strikes in the construction industry and unfavorable weather conditions, output of sand and gravel decreased 6 percent in both quantity and value. Production of sand and gravel for building purposes decreased 15 percent in quantity and 11 percent in value from that of 1967. Sand and gravel produced for road construction, comprising 68 percent of the total tonnage, decreased 2 percent in both quantity and value. Output of fill sand decreased 12 percent in quantity and 9 percent in value.

Production of industrial sands decreased 17 percent in quantity and 21 percent in value owing mainly to a lesser output of molding sands. Uses for industrial sands included engine, filtration, foundry, glassmaking, and oil (hydrafrac) purposes. Industrial sands were produced in Columbia, Dane, Douglas, Eau Claire, Green Lake, Pierce, and Rock Counties. The Wisconsin Geological Survey studied the

Table 5.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	4,301	$3,838	3,583	$3,311
Paving	2,661	1,924	3,460	2,277
Blast	37	131	34	125
Fill	1,860	1,005	1,525	779
Molding	995	2,859	812	2,209
Other [1]	160	202	102	153
Total	10,014	9,959	9,516	8,854
Gravel:				
Building	4,742	4,180	4,074	3,853
Paving	16,115	12,502	13,754	11,167
Railroad ballast	169	101	192	114
Fill	1,655	808	1,672	852
Other	1	1	12	9
Total	22,682	17,592	19,704	15,995
Total sand and gravel	32,696	27,551	29,220	24,849
Government-and-contractor operations:				
Sand:				
Paving	2,035	949	1,935	947
Fill	472	189	208	79
Other	129	54	124	51
Total	2,636	1,192	2,267	1,077
Gravel:				
Building	4	2	--------	--------
Paving	6,707	4,015	7,767	4,698
Fill	499	195	553	279
Total	7,210	4,212	8,320	4,977
Total sand and gravel	9,846	5,404	10,587	[2] 6,053
All operations:				
Sand	12,650	11,151	11,783	9,931
Gravel	29,892	21,804	28,024	20,972
Total	42,542	32,955	39,807	30,903

[1] Includes foundry and other industrial sand (1968), engine, filtration, glass, oil (hydrafrac), railroad ballast, and other construction uses.

[2] Data may not add to totals shown because of independent rounding.

Table 6.—Production of sand and gravel in 1967–68, by counties

(Thousand short tons and thousand dollars)

County	1967		1968		County	1967		1968	
	Quantity	Value	Quantity	Value		Quantity	Value	Quantity	Value
Adams	W	W	W	W	Marquette	74	W	62	W
Ashland	254	W	184	W	Menominee	------	------	------	------
Barron	700	$450	474	$356	Milwaukee	162	$118	314	$222
Bayfield	113	93	254	179	Monroe	193	134	W	W
Brown	585	359	646	W	Oconto	764	W	624	W
Buffalo	60	21	72	25	Oneida	514	313	198	150
Burnett	261	142	217	131	Outagamie	145	168	115	122
Calumet	75	59	189	170	Ozaukee	1,179	934	748	633
Chippewa	349	194	W	W	Pepin	W	W	W	W
Clark	662	531	W	W	Pierce	185	W	148	W
Columbia	838	W	665	W	Polk	W	W	449	W
Crawford	W	W	83	W	Portage	585	526	647	559
Dane	2,002	1,873	2,011	1,922	Price	107	97	W	W
Dodge	952	632	814	W	Racine	1,121	W	662	W
Door	526	303	349	W	Richland	62	44	W	W
Douglas	743	471	1,851	W	Rock	2,074	2,156	2,282	1,906
Dunn	169	W	W	W	Rusk	339	226	261	144
Eau Claire	1,322	1,497	W	W	St. Croix	442	W	468	W
Florence	W	W	56	46	Sauk	544	W	380	W
Fond du Lac	355	W	301	W	Sawyer	206	146	165	92
Forest	160	85	202	112	Shawano	341	W	294	209
Grant	135	111	151	122	Sheboygan	959	658	792	556
Green	63	W	12	W	Taylor	907	460	700	426
Green Lake	356	546	306	513	Trempealeau	W	W	33	14
Iowa	------	------	------	------	Vernon	44	17	W	W
Iron	W	W	43	25	Vilas	199	135	321	202
Jackson	693	632	720	714	Walworth	1,008	855	1,033	897
Jefferson	282	W	349	195	Washburn	128	73	107	W
Juneau	W	W	5	2	Washington	2,345	1,692	2,015	1,333
Kenosha	117	66	394	285	Waukesha	7,580	5,056	5,900	4,263
Kewaunee	571	516	483	451	Waupaca	583	346	468	306
La Crosse	116	W	137	W	Waushara	173	103	147	93
Lafayette	W	W	------	------	Winnebago	1,154	795	745	487
Langlade	592	354	650	425	Wood	557	306	313	150
Lincoln	534	W	515	359	Undistributed [1]	2,291	7,095	5,552	10,812
Manitowoc	901	584	971	676					
Marathon	712	780	513	483	Total	42,542	32,955	39,807	30,903
Marinette	379	203	247	136					

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes production for which no county breakdown is available, and data indicated by symbol W.

use of silica sands from various locations throughout the State for industrial purposes.

Sand and gravel production was recorded from 69 of Wisconsin's 72 counties. Production exceeded 1 million tons in six counties, compared with nine counties in 1967. Leading counties in sand and gravel output, in decreasing order of tonnage, were Waukesha, Rock, Washington, Dane, Douglas, and Walworth. Collectively, these six counties represented 38 percent of the total State output. About 94 percent of the State's 1968 commercial sand and gravel production was hauled by truck, and the remainder by rail. Commercial operations provided about 73 percent of the total output. The remainder was produced by, or under contract for, State and county highway departments. About 92 percent of the total output was processed; the remainder was pit-run material. Average value of Wisconsin's 1968 sand and gravel output was $0.78 per ton, compared with $0.77 per ton in 1967.

Stone.—Stone ranked second in value among all the mineral commodities produced in the State, representing 35 percent of the total value of Wisconsin's 1968 mineral production. Combined production of basalt, granite, limestone and dolomite, marl, quartzite, and sandstone decreased 1 percent in quantity but increased 1 percent in total value. Despite the decrease in tonnage, stone production in 1968 was exceeded only by the record output in 1967.

Crushed and broken stone comprised more than 99 percent in quantity and 85 percent in value of the State's 1968 stone output. Average value of crushed and broken stone was $1.26 per ton in 1968 compared with $1.24 per ton in 1967. Commercial operators produced 94 percent of the 1968 output; the remainder was produced by 16 county highway departments. Nearly 93 percent of the total crushed and broken stone production was transported by truck; the remainder was hauled by rail.

Output of crushed and broken limestone and dolomite (hereafter referred to as limestone), comprising 83 percent of all crushed and broken stone production, was reported from 39 counties. Leading counties, in descending order of tonnage, were Waukesha, Winnebago, Dane, Grant, and Milwaukee. Collectively, these five counties accounted for 40 percent of the total crushed and broken limestone output. Production of crushed limestone for aggregate and roadstone, comprising 88 percent of the total crushed limestone output, decreased 7 percent in quantity and 4 percent in value from that of 1967. Beginning with 1968, a more detailed breakdown of material sold or used for aggregate and roadstone is shown in table 7. Production of agricultural limestone increased 7 percent in quantity and 22 percent in value from that of 1967. Other uses for crushed and broken limestone included barnlime, filler material, filter stone, flux stone, lime, railroad ballast, riprap and jetty stone, rockfill, and stone sand.

More than 1.3 million tons of crushed and broken granite, all used for aggregate and roadstone, was produced in Juneau, Marathon, and Wood Counties, compared with 850,000 tons in 1967. Most of the increase was due to a larger output in Marathon County.

Crushed and broken quartzite was produced in Marathon and Sauk Counties. Use patterns, in decreasing order of quantity, included railroad ballast, roofing granules, roadstone, and abrasives.

Table 7.—Limestone and dolomite sold or used by producers, by uses

Use	1967		1968	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough architectural ---------------- thousand cubic feet --	17	$26	60	$52
Other rough construction:				
Irregular-shaped stone --------- thousand short tons --	19	238	7	81
Rubble -- do ----	24	222	24	239
Dressed architectural:				
Cut -------------------------- thousand cubic feet --	33	128	37	127
House stone veneer ----------------------------- do ----	316	618	315	797
Sawed --- do ----	50	149	18	66
Other dressed construction ----------------------- do ----	------	--------	31	43
Flagging -- do ----	69	76	97	96
Total dimension ----- approximate thousand short tons --	83	[1] 1,456	76	1,501
Crushed and broken:				
Concrete aggregate and roadstone:				
Concrete aggregate ------------ thousand short tons --	NA	NA	928	1,188
Bituminous aggregate --------------------------- do ----	NA	NA	1,188	1,380
Macadam aggregates ---------------------------- do ----	NA	NA	929	1,128
Dense graded road base stone ------------------ do ----	NA	NA	5,857	6,505
Surface treatment aggregates ------------------ do ----	NA	NA	3,482	3,694
Total aggregate and roadstone [1] ------------ do ----	13,374	14,424	12,384	13,895
Agricultural limestone ----------------------------- do ----	927	1,355	996	1,653
Flux --- do ----	W	W	36	52
Riprap --- do ----	50	63	W	W
Other [2] -- do ----	336	874	610	968
Total crushed and broken [1] -------------------- do ----	14,686	16,716	14,026	16,568
Grand total ------------------------------------ do ----	14,769	18,172	14,102	18,069

NA Not available.
W Withheld to avoid disclosing individual company confidential data; included with "Other".
[1] Data may not add to totals shown because of independent rounding.
[2] Includes stone used for filter stone (1968); asphalt filler and other fillers or extenders; lime; railroad ballast; other and unspecified uses; and items indicated by symbol W.

Table 8.—Stone production, by counties

(Thousand short tons and thousand dollars)

County	1967		1968		Kind of stone produced in 1968 [1]
	Quantity	Value	Quantity	Value	
Ashland	W	W	(2)	W	Granite.
Brown	429	W	552	$558	Limestone.
Buffalo	254	$274	193	226	Do.
Burnett	2	1	6	2	Marl.
Calumet	176	197	136	211	Limestone.
Clark	------	------	(2)	1	Sandstone.
Columbia	87	101	W	W	Limestone.
Crawford	369	W	W	W	Do.
Dane	1,097	1,327	1,043	1,246	Do.
Dodge	378	W	347	W	Do.
Door	7	29	14	W	Do.
Dunn	W	W	193	260	Do.
Fond du Lac	488	1,313	491	1,088	Do.
Grant	865	716	940	856	Do.
Green	446	W	456	W	Do.
Green Lake	22	24	20	27	Do.
Iowa	463	378	298	293	Do.
Jefferson	W	W	16	12	Do.
Juneau	W	W	W	W	Granite and limestone.
La Crosse	W	W	W	W	Limestone.
Lafayette	473	301	542	498	Do.
Manitowoc	170	W	160	W	Do.
Marathon	1,198	2,980	1,684	3,279	Granite, quartzite, and sandstone.
Marinette	W	W	W	W	Granite and traprock.
Marquette	25	W	W	W	Granite.
Milwaukee	W	W	W	W	Limestone.
Monroe	160	204	187	W	Do.
Oconto	W	W	W	W	Do.
Outagamie	425	438	520	530	Do.
Pepin	78	W	31	W	Do.
Pierce	222	173	W	W	Do.
Polk	W	W	312	W	Limestone and traprock.
Portage	(2)	1	------	------	
Racine	W	W	W	W	Limestone.
Richland	W	W	W	W	Do.
Rock	356	307	398	396	Do.
St. Croix	219	W	258	W	Do.
Sauk	843	1,105	W	W	Limestone, quartzite, and sandstone.
Shawano	54	W	20	31	Limestone.
Sheboygan	47	47	17	29	Do.
Trempealeau	129	W	107	112	Do.
Vernon	480	W	298	W	Do.
Waukesha	1,668	W	1,788	3,254	Do.
Waupaca	27	20	28	30	Do.
Winnebago	1,367	1,776	1,139	1,636	Do.
Wood	151	176	189	146	Limestone, granite, and sandstone.
Undistributed [3]	3,945	12,979	4,616	10,500	
Total [4]	17,122	24,863	17,000	25,223	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] "Limestone" used generally to include dolomite.

[2] Less than ½ unit.

[3] Includes production for which no county breakdown is available, and data indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Crushed and broken basalt, used for railroad ballast, riprap, roadstone, and roofing granules, was produced in Polk and Marinette Counties.

Calcareous marl was produced in Burnett County for agricultural purposes.

Production of dimension stone, by type and in decreasing order of value, consisted of granite, limestone, and sandstone (including some quartzite). Total output decreased 7 percent in quantity but increased 4 percent in value. Granite constituted 11 percent of the quantity and 60 percent of the value of all dimension stone produced in the State. Production of dimension granite remained nearly unchanged in quantity and increased 4 percent in value from that of 1967. Dimension granite was produced by 7 companies operating quarries in Ashland, Marathon, Marinette, and Marquette Counties. Rough and dressed monumental stone accounted for 98 percent of the total dimension granite sales; the remainder was sold for architectural purposes.

Limestone represented 87 percent in quantity and 39 percent in value of all dimension stone produced in the State. Output decreased 8 percent in quantity but increased 3 percent in value. The greatest increase in total value occurred in sales of house stone veneer, which accounted for 33 percent of the volume and 53 percent of the value of all dimension limestone produced in the State. Other types of dimension limestone, in descending order of value, were rubble, cut stone, flagging, irregular-shaped rough construction stone, sawed stone, rough architectural, and other dressed construction stone. Dimension limestone was produced by 31 companies in seven counties. Waukesha and Fond du Lac were the leading counties, representing 90 percent in quantity and 88 percent in value of the State's 1968 dimension limestone output. Wisconsin supplied about 13 percent in quantity and 9 percent in value of the Nation's dimension limestone output, ranking second in both quantity and value of production among the States.

Dimension sandstone (including some quartzite) was produced by six companies in Clark, Marathon, Sauk, and Wood Counties. Output decreased 17 percent in quantity but increased 3 percent in value. Uses for dimension sandstone, in descending order of value, were house stone veneer, flagging, cut stone, rubble, and other dressed construction stone.

Vermiculite.—Zonolite Division, W. R. Grace & Co., produced exfoliated vermiculite at its Milwaukee plant from crude material mined outside the State. The expanded material was used for loose fill insulation, lightweight aggregate in concrete and building plaster, and for agricultural purposes. Output increased in quantity and decreased in value from that of 1967.

METALS

Iron Ore.—Jackson County Iron Co., a subsidiary of Inland Steel Co., continued construction of its 750,000-ton-per-year taconite plant near Black River Falls. Construction was started in 1967 and was scheduled to be completed by October 1969. At yearend, the plant was about one-third completed with more than half the concrete in place. Equipment installation, including the Dravo-Lurgi traveling grate indurating furnace, had begun. Daily pellet shipments on a year-round basis, were scheduled to Inland Steel Co.'s Indiana Harbor Works, East Chicago, Ind. Production from this operation will be the first iron ore mining in Wisconsin since the Cary mine on the Gogebic Range ceased production in 1965.

Iron ore, produced in Minnesota, was shipped by lake vessel from ore docks operated at Superior by Great Northern Railway Co. and the Northern Pacific Railway Co. The shipping season for iron ore from the port of Superior began April 14 and ended December 15.

Lead and Zinc.—Zinc output, in terms of recoverable metal, decreased 11 percent in quantity and 13 percent in value from that of 1967. Production of lead decreased 29 percent in quantity and 33 percent in value. The larger decrease in lead output was attributed to the closing of several mines which yielded a larger percentage of lead than most in the district. Wisconsin producers supplied about 5 percent of the Nation's zinc output, ranking seventh in production of this metal.

Average yearly weighted prices of lead and zinc were 13.21 cents per pound for lead and 13.50 cents per pound for zinc, compared with 14.00 cents for lead and 13.84 cents for zinc in 1967.

Lead and zinc were produced by four companies operating underground mines in Grant, Iowa, and Lafayette Counties. American Zinc Co. operated its Champion and Temperly-Thompson mines near New Diggings. Ores from these mines were treated at the company's Vinegar Hill mill near Shullsburg. In November, American Zinc Co. began production from its Bear Hole mine near Shullsburg. Earlier in the year, the company closed its Blackstone-Hancock-Winskell mine near Shullsburg, and its Tennyson mine and mill near Tennyson. Eagle-Picher Industries, Inc., operated its Birkett-Bastian-Andrews mine near Hazel Green and its Shullsburg mine near Shullsburg throughout the year. The former mine was nearing depletion at yearend. Ores from the Birkett-Bastian-Andrews mine were treated at the company's mill in Galena, Ill., and ores from the Shullsburg mine at its Shullsburg mill. The New Jersey Zinc Co. operated its mill and McNett No. 1 mine near Elmo in Grant County. The company also mined a lesser

Table 9.—Mine production of lead and zinc, in terms of recoverable metals

Year	Mines producing	Ore treated (short tons)	Lead		Zinc		Total value[1] (thousands)
			Short tons	Value (thousands)	Short tons	Value (thousands)	
1964	13	849,943	1,742	$456	26,278	$7,148	$7,604
1965	16	967,083	1,645	513	26,993	7,882	8,395
1966	16	936,432	1,694	512	24,775	7,185	7,697
1967	13	988,798	1,596	447	28,953	8,016	8,463
1968	11	923,308	1,126	298	25,711	6,942	7,239

[1] Data may not add to totals shown because of independent rounding.

amount of ore from its McNett No. 2 mine in Lafayette County. Late in the year, the company began driving a new incline on the Kopp property near Platteville. Near Mineral Point, Ivey Construction Co. temporarily ceased operations at its Graysville mine and at its nearby mill. The company began driving a new incline on the Graysville property; production was scheduled to resume in 1969.

The aforementioned companies all conducted exploratory drilling at various locations in Grant, Iowa, and Lafayette Counties. American Zinc Co. reported substantial increases in reserves in the area near the Champion mine. In addition, D. H. & S. Mining Co. did exploratory drilling in Green County near Argyle. Some drilling was delayed because of unfavorable weather conditions and the continued drop in price of lead and zinc. Other types of exploratory activities included electromagnetic surveying and geochemical sampling of spring water.

Tailings from several lead-zinc milling operations were used for road construction, railroad ballast, agricultural, and other purposes. The University of Wisconsin studied the possibility of producing dolomitic lime and other mineral commodities from lead-zinc mining and milling wastes. Activities included analyses of markets for lime, sulfur, and iron oxide and examining the physical and chemical characteristics of the waste material.

Other Metals.—The discovery of nodules containing a considerable amount of iron and about 9 percent manganese on the bottom of Green Bay along the Michigan-Wisconsin border was announced by a University of Wisconsin marine geologist.

Vulcan Materials Co., A & M Division, began construction of a secondary aluminum smelter in Milwaukee County near Oak Creek. Production was expected to begin in 1969.

MINERAL FUELS

Peat.—Sales of peat increased in quantity and value over those of 1967. Major reason for the increase was greater sales of peat used for seed inoculant, which comprised 90 percent of the State's 1968 peat output. The remainder was sold for general soil improvement and packing shrubs and other plants. Nearly 91 percent of the total output was sold in bulk form. Peat was produced by two companies in Lincoln and Waukesha Counties. One company produced humus peat; the other, moss and humus. H. Geipel's Custom Soil, Inc., Waukesha County, did not produce peat in 1968.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasive stone—Grinding pebbles: Baraboo Quartzite Co., Inc.	128 9th Ave., Box 363 Baraboo, Wis. 53913	Quarry; stationary plant.	Sauk.
Cement: Marquette Cement Mfg. Co.	20 N. Wacker Dr. Chicago, Ill. 60606	Portland and masonry, dry process.	Milwaukee.
Clays and shale:			
Oakfield Shale Brick & Tile Co.	Oakfield, Wis. 53065	Pit and plant	Fond du Lac.
Red Cedar Brick Co., Inc	790 Joy Ave. St. Paul, Minn. 55118	do	Dunn.
Red Wing Sewer Pipe Corp	Red Wing, Minn. 55066	Processed stockpiled material.	Pierce.
Union Grove Drain Tile Co	Box 348 Union Grove, Wis. 53182	Pit and plant	Racine.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coke: Milwaukee Solvay Coke Div. Pickands Mather & Co.	311 E. Greenfield Ave. Milwaukee, Wis. 53204	Coke ovens	Milwaukee.
Lead and zinc:[1]			
American Zinc Co.:			
No. 1 and No. 2	20 S. 4th St. St. Louis, Mo. 63101	Mines and mill	Grant.
Bear Hole		Mine; ore treated at Vinegar Hill mill.	Lafayette.
Blackstone-Coulthard-Hancock-Winskell.		do	Do.
Champion		do	Do.
Temperly-Thompson		do	Do.
Vinegar Hill mill		Mill	Do.
Eagle-Picher Industries, Inc.:			
Birkett-Bastian-Andrews.	Box 1040 Galena, Ill. 61036	Mine; ore treated at Graham mill, near Galena, Ill.	Do.
Shullsburg		Mine and mill	Do.
Ivey Construction Co.: Graysville.	128 High St. Mineral Point, Wis. 53565	do	Iowa.
The New Jersey Zinc Co.:			
Elmo No. 1	160 Front St. New York, N.Y. 10038	do	Grant.
Elmo No. 2		Mine; ore treated at Elmo No. 1 mill.	Lafayette.
Kopp No. 3		Development work only	Grant.
Lime:			
Cutler-LaLiberte-McDougall Corp.	1116 Fidelity Bldg. Duluth, Minn. 55802	Quick and hydrated, 2 rotary kilns, 1 continuous hydrator.	Douglas.
Rockwell Lime Co	228 N. LaSalle St. Chicago, Ill. 60601	Quick and hydrated, 1 rotary kiln, 1 continuous hydrator.	Manitowoc.
The Western Lime & Cement Co.:			
Green Bay plant	Box 2076 Milwaukee, Wis. 53201	Quick and hydrated, 5 shaft kilns, 1 batch hydrator.	Brown.
Knowles plant		Hydrated, 5 shaft kilns, 1 continuous hydrator.	Dodge.
Eden plant		Quick and hydrated, 5 shaft kilns, 1 batch hydrator.	Fond du Lac.
Peat: Demilco, Inc	3101 W. Custer Ave. Milwaukee, Wis. 53209	Bog, processing plant	Waukesha.
Expanded perlite:			
Midwest Perlite Co	912 College Ave. Appleton, Wis. 54911	Processing plant	Outagamie.
Zonolite Division, W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	do	Milwaukee.
Sand and gravel:			
Eau Claire Sand & Gravel Co.	104 Gibson St. Eau Claire, Wis. 54701	Pits; portable and stationary plants.	Chippewa, Dunn, Eau Claire.
Janesville Sand & Gravel Co	1110 Harding St. Janesville, Wis. 53545	Pits; stationary plants	Rock.
Johnson Sand & Gravel, Inc	22750 W. Bluemound Rd. Waukesha, Wis. 53186	Pits; portable plants	Waukesha.
Edward Kraemer & Sons, Inc.	Plain, Wis. 53577	do	Barron, Dane, Douglas, Eau Claire, Jackson, Kenosha, Milwaukee, Monroe, Ozaukee, Portage, Racine, Richland, Sauk, Sheboygan, Vernon, Vilas, Walworth, Washington, Waukesha, Waupaca.

See footnote at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
C. C. Linck, Inc	1226 N. Center St. Beaver Dam, Wis. 53916	Pits; portable plants	Columbia, Dodge, Fond du Lac, Manitowoc, Marquette, Ozaukee.
McLean Construction Co	1255 Tower Ave. Superior, Wis. 54880	Pits; dredge; portable plants.	Bayfield, Burnett, Douglas.
Manley Sand Div. Martin Marietta Corp.	Rockton, Ill. 61072	Pit; stationary plant	Columbia.
Mann Brothers Sand & Gravel, Inc.	Box 48 Elkhorn, Wis. 53121	Pits; portable plants	Jefferson, Kenosha, Walworth, Waukesha.
Arthur Overgaard, Inc	Box 87 Elroy, Wis. 53929	do	Various counties.
State Sand & Gravel Co	10833 W. Watertown Plank Rd. Milwaukee, Wis. 53326	Pits; stationary plants	Waukesha.
Wissota Sand & Gravel Co	818 One Half Eau Claire Eau Claire, Wis. 54701	do	Bayfield, Eau Claire, Jackson, Washington.
Stone:			
Granite:			
Anderson Bros. & Johnson Co.	Box 26 E. Manson St. Wausau, Wis. 54401	Quarries; stationary plant.	Marathon, Marinette.
Gottschalk Brothers, Inc.	Route 2 Edgar, Wis. 54426	Quarry; portable plant	Marathon.
Lawrence Ladick, Inc	Route 1 Vesper, Wis. 54455	Quarry	Do.
Lake Wausau Granite Co.	2d St., Box 397 Wausau, Wis. 54401	Quarry; stationary plant.	Do.
Montello Granite Co	Montello, Wis. 53949	do	Marquette.
Prehn Granite Quarries, Inc.	1108 Hamilton Wausau, Wis. 54401	do	Marathon.
Limestone and dolomite:			
Courtney & Plummer, Inc.	Box 351 Neenah, Wis. 54956	Quarries; stationary and portable plants.	Winnebago.
Daanen & Janssen	214 S. Huron St. De Pere, Wis. 54115	Quarries; portable plants.	Brown.
Halquist Lannon Stone Co.	Sussex, Wis. 53089	Quarries; stationary plant.	Waukesha.
Edward Kraemer & Sons, Inc.	Plain, Wis. 53577	Quarries; portable plants.	Columbia, Crawford, Dunn, La Crosse, Monroe, Pierce, Richland, Sauk, Vernon, Wood.
Arthur Overgaard, Inc	Box 87 Elroy, Wis. 53929	Quarries; stationary and portable plants.	La Crosse, various counties.
P. W. Ryan Sons, Inc	Box 1079 Janesville, Wis. 53545	Quarries; portable plants.	Green, Rock.
Vulcan Materials Co. Midwest Division.	29 N. Wacker Dr. Chicago, Ill. 60606	Quarries; stationary plants.	Milwaukee, Racine, Waukesha, Winnebago.
Waukesha Lime & Stone Co.	Box 708 Waukesha, Wis. 53186	Quarry; stationary plant.	Waukesha.
George Wendtlandt, Inc.	Mineral Point, Wis. 53565	Quarries; portable plants.	Grant, Iowa, Lafayette.
Quartzite:			
Foley Bros., Inc	450 Endicott on 4th St. Paul, Minn. 55100	Quarry; stationary plant.	Sauk.
Minnesota Mining & Mfg. Co.	2501 Hudson Rd. St. Paul, Minn. 55119	Quarries; stationary plant.	Marathon.

See footnote at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Sandstone:			
Ellis Quarries, Inc	Stevens Point, Wis. 54481	Quarries; stationary plant.	Clark, Marathon, Wood.
Hildebrandt Stone Co	6824 University Ave. Middleton, Wis. 53562	Quarry; stationary plant.	Sauk.
Traprock (basalt):			
Bryan Dresser Trap Rock, Inc.	Box 215 Shakopee, Minn. 55379	Quarry; stationary and portable plants.	Polk.
GAF Corp.[2]	Pembine, Wis. 54156	Quarry; stationary plant.	Marinette.
Vermiculite, exfoliated: Zonolite Div., W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 01109	Processing plant	Milwaukee.

[1] All lead-zinc mining was by underground methods.

[2] Name changed from The Ruberoid Co. Div. of General Aniline & Film Corp.

The Mineral Industry of Wyoming

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Wyoming for collecting information on all minerals except fuels.

By Earl F. Brauch [1] and William C. Henkes [2]

The total value of mineral production in the State increased for the third year and reached a new record high. The total output for 1968 was valued at $576.2 million, $45.5 million (9 percent) over that of the previous year. The gain was due to increased production of petroleum, portland cement, gypsum, sand and gravel, stone, sodium carbonate, iron ore, and uranium.

Energy minerals contributed 85 percent of the total value, crude petroleum, natural gas, and natural gas liquids accounted for almost 75 percent, dwarfing uranium, the next largest mineral commodity in terms of value. Fossil fuels had the largest dollar value gains, $29.9 million, an increase of 7 percent in value during the year in spite of the 7 percent decline in the value of LP gases. Masonry cement and phosphate rock declined both in output and value. No production was reported for pumice, vermiculite, and vanadium. Uranium contributed nearly 8 percent of Wyoming's mineral wealth, but comprised almost 70 percent of the value of metals.

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[1] Mining engineer, Bureau of Mines, Denver, Colo.

[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1.—Mineral production in Wyoming [1]

Mineral	1967 Quantity	1967 Value (thousands)	1968 Quantity	1968 Value (thousands)
Clays — thousand short tons	1,495	$14,313	1,828	$17,275
Coal (bituminous) — do	3,588	11,876	3,829	12,117
Gem stones	NA	125	NA	127
Iron ore (usable) — thousand long tons, gross weight	1,854	19,186	1,967	19,452
Lime — thousand short tons	25	W	28	W
Natural gas (marketed) — million cubic feet	240,074	35,051	248,481	36,278
Natural gas liquids:				
LP gases — thousand 42-gallon barrels	4,139	7,648	3,917	7,090
Natural gasoline and cycle products — do	2,361	6,447	2,331	6,501
Petroleum (crude) — do	136,312	351,685	144,250	380,589
Sand and gravel — thousand short tons	8,181	8,253	9,350	8,973
Stone — do	1,246	2,375	1,434	2,754
Uranium (recoverable content U_3O_8) — thousand pounds	4,655	[2] 37,243	5,928	[3] 44,343
Value of items that cannot be disclosed: Cement, feldspar, gypsum, phosphate rock, pumice (1967), sodium carbonate, sodium sulfate, vanadium (1967), vermiculite (1967), and values indicated by symbol W	XX	36,494	XX	40,691
Total	XX	530,696	XX	576,190
Total 1957–59 constant dollars	XX	r 516,546	XX	p 560,440

p Preliminary. r Revised. NA Not available. W Withheld to avoid disclosing individual company data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Estimated based on $8.00 per pound f.o.b. mill.

[3] Estimated based on $8.00 per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 per pound for commercial sales.

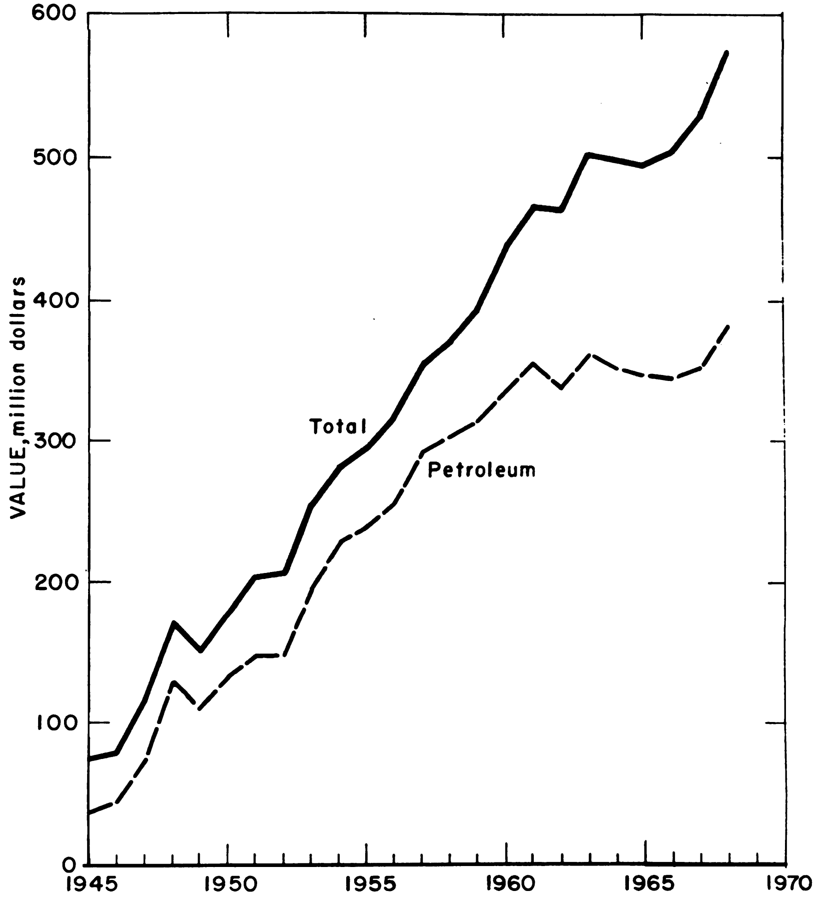

Figure 1.—Value of petroleum, and total value of mineral production in Wyoming.

Highlights of the mineral industry during the year may be summarized as follows:

The $73 million expansion of the powerplant and supporting facilities of Pacific Power & Light Co. (PP&L) near Glenrock—one of the largest industrial construction projects in the history of the State.

Approval by the Wyoming Public Service Commission of construction of a $6 million, 20-megawatt generating unit at the Wyodak plant near Gillette by Black Hills Power & Light Co.

The expansion by 220 megawatts of Utah Power & Light Co.'s Naughton powerplant near Kemmerer.

Completion of the Industrial Chemicals Division, Allied Chemical Corp., soda ash complex at Green River.

The continued expansion of the FMC Co. and the Stauffer Chemical Company of Wyoming soda ash plants.

The construction of a mine shaft by Texas Gulf Sulphur Co. (TGS) at its trona deposit.

Table 2.—Value of mineral production in Wyoming, by counties

(Thousands)

County	1967	1968	Minerals produced in 1968 in order of value
Albany	$4,959	$7,147	Cement, petroleum, sand and gravel, iron ore, stone, gypsum, feldspar.
Big Horn	23,843	27,216	Petroleum, clays, natural gas, gypsum, lime, sand and gravel, uranium.
Campbell	[r] 29,009	52,602	Petroleum, coal, natural gas, sand and gravel, LP gases.
Carbon	[r] 18,989	21,117	Uranium, petroleum, natural gas, coal, LP gases, sand and gravel, natural gasoline, stone.
Converse	[r] 17,495	14,426	Petroleum, coal, natural gas, LP gases, sand and gravel.
Crook	[r] 19,737	21,845	Petroleum, clays, natural gasoline, LP gases, natural gas, sand and gravel, uranium, stone.
Fremont	[r] 82,214	89,520	Uranium, petrolum, iron ore, natural gas, natural gasoline, sand and gravel, LP gases, stone.
Goshen	329	610	Sand and gravel, lime, petroleum, stone.
Hot Springs	43,674	42,792	Petroleum, natural gas, coal, natural gasoline, sand and gravel, stone.
Johnson	[r] 22,678	18,705	Petroleum, clays, sand and gravel, natural gas, LP gases, natural gasoline, stone.
Laramie	2,920	3,329	Petroleum, stone, sand and gravel, natural gas.
Lincoln	[r] 8,539	8,174	Coal, natural gasoline, LP gases, phosphate rock, sand and gravel.
Natrona	[r] 54,407	52,870	Petroleum, natural gas, LP gases, sand and gravel, natural gasoline, uranium, clays, sodium sulfate, feldspar, stone.
Niobrara	[r] 2,086	1,993	Petroleum, sand and gravel, natural gas, LP gases, stone.
Park	[r] 90,924	100,675	Petroleum, natural gas, LP gases, sand and gravel, gypsum, natural gasoline, stone.
Platte	W	3,760	Iron ore, stone, sand and gravel.
Sheridan	2,749	3,410	Coal, petroleum, sand and gravel, stone.
Sublette	[r] 20,670	20,702	Petroleum, natural gas, sand and gravel, LP gases.
Sweetwater	[r] 60,854	64,715	Sodium carbonate, petroleum, natural gas, coal, sand and gravel, LP gases, natural gasoline, stone.
Teton	W	281	Stone, sand and gravel.
Uinta	1,787	1,793	Natural gas, sand and gravel, natural gasoline, petroleum, clays.
Washakie	[r] 8,117	9,107	Petroleum, natural gas, sand and gravel, LP gases, lime.
Weston	[r] 10,495	9,180	Petroleum, clays, natural gas, LP gases, sand and gravel.
Yellowstone National Park.	14	92	Stone, sand and gravel.
Undistributed	[1] 4,207	127	Gem stones.
Total [2]	530,696	576,190	

[r] Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Wyoming business activity

		1967 [r]	1968 [p]	Change (percent)
Employment and labor force, annual average:				
Total labor force	thousands	134.0	139.2	+3.9
Total employment	do	128.5	133.9	+4.2
Total unemployment	do	5.5	5.3	—3.6
Total agricultural employment	do	16.3	16.9	+3.7
Total nonagricultural employment	do	112.2	117.0	+4.3
Mining	do	9.1	10.8	+18.7
Contract construction	do	6.5	7.1	+9.2
Manufacturing	do	7.0	6.6	—5.7
Government	do	27.8	28.5	+2.5
Trade	do	21.3	22.5	+5.6
All other	do	40.5	41.5	+2.5
Personal income:				
Total	millions	$946	$989	+4.5
Per capita		$2,997	$3,139	+4.7
Construction activity:				
Cement shipments to and within the State	thousand 376-pound barrels	1,003	993	—1.0
Total value—construction contracts	millions	$107.6	$89.7	—16.6
Residential	do	$24.5	$15.2	—38.0
Nonresidential	do	$83.1	$74.5	—10.3
Highway construction contracts awarded	do	$37.7	$36.1	—4.2
Farm marketing receipts	do	$203	$212.8	+4.8
Mineral production	do	$530.7	$576.2	+8.6
Electric power used	million kilowatt-hours	2,385.1	2,656.2	+11.4
Natural gas used	billion cubic feet	50.2	59.4	+18.3

[p] Preliminary. [r] Revised.

Sources: Employment Security Commission of Wyoming; Engineering News-Record, v. 182, No. 14, Apr. 3, 1969, pp. 52–53; Public Service Commission, Cheyenne, Wyo.; Survey of Current Business, v. 49, No. 4, April 1969, p. 17; University of Wyoming, Office of Economic Research. F. W. Dodge Division, McGraw Hill Information Systems Co.

The acquisition of coal lands by such petroleum companies as Sun Oil Co., Continental Oil Co., and Humble Oil & Refining Co.

The negotiation of a 30-year water agreement for 25,000 acre feet per year of industrial water from Fontenelle Reservoir by Sun Oil Co. The company plans to use the water to develop coal that may be produced in the area. This was the first sale of State industrial water.

The optioning of Yellowtail Reservoir water by Humble Oil & Refining Co., Kerr-McGee Corp., and Shell Oil Co., and the negotiating by Peabody Oil Co. and Sun Oil Co. for Yellowtail Reservoir water, for possible use in a new industry in Wyoming to convert coal into synthetic fuels.

The start of construction by Sinclair Oil & Gas Co. on a $5.5 million gas-processing plant near Gillette.

The reopening of the Casper oil refinery by Little America Stations, Inc.

The continued acceleration of uranium activities over a large part of the State. Principal activities were the planned construction by Utah Construction & Mining Co. of a $20 million mine and mill for the Shirley basin area; a Kerr-McGee Corp. uranium discovery and development in the Powder River basin; a Kennecott Copper Corp. sulfuric acid bulk-storage station at Medicine Bow; and the leasing, exchanging, or selling of large blocks of leases and claims by such companies as American Nuclear Corp., Atlantic Richfield Co., Consolidated Oil & Gas, Inc., Congo Uranium Co., Golden Cycle Corp., New Park Mining Co., Western Standard Uranium, Inc., Silver Bell Mines Co., W. R. Grace & Co., Union Carbide Corp., and Vipont Mining Co., involving lands in the Crooks Gap, Shirley basin, Powder River basin, and other areas.

Employment and Injuries.—Final data for 1967 and preliminary data for 1968 compiled by the Bureau of Mines for employment and injuries in the Wyoming mineral industries, excluding all mineral fuels except coal, are reported in table 4.

Government Programs.—The Bureau of Mines Laramie Petroleum Research Center continued work on such projects as petroleum extraction research, petroleum processing and utilization, and oil-shale and shale-oil research.

The University of Wyoming's Natural Resources Research Institute received a $600,000 contract from the U.S. Office of Coal Research for a project to convert coal to gasoline. The contract is the first Federal research contract of this type ever granted in the Rocky Mountain area.

The U.S. Bureau of Reclamation continued a preliminary water study during the year to determine the feasibility of diversion of water from the Green River to the North Platte River.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1967:								
Coal	318	224	71	549	-------	14	25.50	2,125
Metal	1,686	246	415	3,413	1	89	26.37	4,389
Nonmetal	1,326	245	324	2,637	1	52	20.10	2,871
Sand and gravel	980	186	183	1,444	-------	25	17.31	385
Stone	267	212	56	453	-------	13	28.68	7,064
Total [1]	4,577	229	1,050	8,497	2	193	22.95	3,234
1968:[p]								
Coal	310	228	71	540	1	14	27.80	12,442
Metal	1,725	266	462	3,889	4	104	27.77	7,272
Nonmetal	1,250	286	358	2,894	1	46	16.24	2,841
Sand and gravel	810	188	152	1,252	1	23	19.18	5,666
Stone	250	251	62	500	-------	14	28.02	766
Total [1]	4,345	253	1,105	9,074	7	201	22.92	5,586

[p] Preliminary.

[1] Data may not add to totals shown because of independent rounding.

In conjunction with the U.S. Forest Service, the U.S. Bureau of Land Management made application to withdraw for 20 years approximately 6,900 acres of land about 25 miles southeast of Rawlins in Carbon County for use in watershed research. Lands will be closed to mining location and surface disposal. Mineral leasing and other uses compatible with the research project will be allowed.

Under the year's highway budget, contracts awarded for construction totaled $36.1 million; of this amount, $19.7 million was for the Interstate Highway system, $9.4 million for primary and secondary roads in the Federal-aid program (ABC contracts), and $7 million for State-financed roads.[3] Highway expenditures in 1968 were 4 percent below those reported for 1967.

Total designated mileage of the federally authorized Interstate system for 1968 was adjusted to 914.0 miles. Of this amount 654.1 miles were opened to traffic, 101.2 miles were under construction, 76.3 miles were being designed or right-of-way acquired, and 82.4 miles were under preliminary consideration. Wyoming ranks 19th in the number of miles allocated under the Interstate system.[4] The quantities of sand and gravel, stone, and cement used in highway construction decreased during the year owing to smaller appropriations.

The Bureau of Mines, the U.S. Geological Survey, and others published reports on the mineral industry of Wyoming.[5]

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The fossil fuels (coal, natural gas, natural gas liquids, and petroleum) continued to be the major economic contributors to Wyoming's mineral wealth, a position held in the State since the beginning of the century. Revenue from fossil fuels comprised almost 77 percent of the total value of mineral production. Crude petroleum, again the most valuable mineral, amounted to 66 percent of the total value of mineral production—the same percentage it held in 1967. Petroleum has shown a growth in revenue over the years but a gradual decline in percentage of the total mineral revenue. for the State. Natural gas was again the third most valuable commodity. Value of natural gas increased $1.2 million during 1968 to $36.3 million but declined from 7 to 6 percent of the State's total mineral output value.

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[3] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1969 and Budgets for Maintenance. V. 182, No. 14, Apr. 3, 1969, pp. 52–53.

[4] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1968. Press Release FHWA-295, Feb. 24, 1969.

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Coal (Bituminous).—As a result of a 7-percent increase in tonnage, the value of coal increased $241,000 to $12.1 million. The 3.8 million tons produced came from 13 mines in seven counties. Increases in production were in Campbell, Carbon, Hot Springs, Lincoln, and Sheridan Counties; the largest increase was from Lincoln County. Decreases occurred in Converse and Sweetwater Counties.

Three coal-powered generating plants were approved for expansion by the Wyoming Public Service Commission. PP&L is planning construction in 1969 of a $62 million unit at the Dave Johnston plant near Glenrock. An additional $11 million will be spent on transmission facilities and mining equipment bringing the total expenditure to $73 million. The additional facilities—the largest industrial expansion in the State—will almost double the capacity of the present 420-megawatt, 3-unit plant to 750 megawatts by 1972. Coal for the plant is shipped approximately 16 miles by rail from the mine.

The second largest industrial expansion in the State was the Naughton plant of Utah Power & Light Co. near Kemmerer. This third expansion of the plant, based on an application for a $51 million, 330-megawatt steam-generating unit to be completed in 1971, will increase plant output to 715 megawatts. The second unit of the plant, costing $33 million and producing 220 megawatts, was under construction during the year. The third addition will consume 1 million tons of coal annually, bringing the total requirements to 2.5 million tons per year.

Black Hills Power & Light Co. is planning a $6 million expansion at its Wyodak generating plant near Gillette. The plant, to increase capacity by 20 megawatts, is a new design utilizing air-cooled condensers to reduce water consumption.

According to the company annual report, PP&L geologists added an additional 200 million tons of coal reserves in east-central Wyoming for use at the Dave Johnston plant. The additional tonnage more than doubles the reserves in that area. Approximately 35 miles northeast of Rock Springs, the same company also proved up 100 million tons of low-cost coal reserves.

Major oil companies and other firms and individuals have been actively acquiring coal properties. Some 76,000 acres have been leased in Campbell County to companies including Atlantic Richfield Co., Humble, Kerr-McGee, and PP&L. Applications have been filed for 100,000 acres of coal leases in the Gillette area. Sun Oil Co. leased 14,679 acres of coal lands northeast of Rock Springs estimated to contain over 600 million tons of coal. Union Pacific Railroad Co. owns alternating tracts in the area. Humble has spent over $25 million in several States, including Wyoming, for coal reserves, research, and staff.

Natural Gas.—Marketed natural gas increased 3.5 percent in quantity and in value, 8.4 billion cubic feet and $1.2 million, respectively. According to the State Oil and Gas Conservation Commission, there were 787 active gas wells in the State at yearend, 38 more (up 5 percent) than in 1967. Again the leading gas-producing counties were Sublette, Sweetwater, and Fremont.

Table 5.—Coal (bituminous) sold or used[1] in 1968, by counties

County	Number of mines operating			Sold or used (thousand short tons)		
	Underground	Strip	Total	Underground	Strip	Total
Campbell	-------	1	1	-------	540	540
Carbon	-------	2	2	-------	477	477
Converse	-------	2	2	-------	1,390	1,390
Hot Springs	3	-------	3	10	-------	10
Lincoln	-------	2	2	-------	952	952
Sheridan	-------	2	2	-------	354	354
Sweetwater	1	-------	1	106	-------	106
Total[2]	4	9	13	117	3,713	3,829

[1] Excludes mines producing less than 1,000 short tons.
[2] Data may not add to totals shown because of independent rounding.

The Big Piney-LaBarge complex of gasfields in Lincoln and Sublette Counties is by far the largest gas-producing area in the State. Located in the northwestern part of the Green River basin, the area accounted for 28 percent of total gas production. Major individual fields within the complex and their production (in billion cubic feet) were LaBarge, including East and North LaBarge, (16.4), Hogsback (14.1), and Tip Top Unit (12.8).

The Patrick Draw-Desert Springs area, Sweetwater County, yielded 28.1 billion cubic feet of gas from five individual fields. Beaver Creek field, Fremont County, had an output of 17.8 billion cubic feet; Elk Basin field, Park County, yielded 14.6 billion; and Worland field, Washakie County, produced 14.5 billion.

Estimates by the American Petroleum Institute (API) and American Gas Association, Inc. (AGA), gave Wyoming gas reserves of 3.8 trillion cubic feet as of January 1, 1969, a net increase of 83.1 billion cubic feet. New fields and new pools added 60.4 billion cubic feet; extensions and revisions added 290.3 billion cubic feet.[6]

Of the eight gas discoveries reported during the year, one of the most significant was the Madden Deep Unit in Fremont County. With combined flow rates on three drillstem tests of 54 million cubic feet of gas per day, the Wolf Exploration Co., No. 1 Madden Deep Unit, NW¼ SW¼ sec 2, T 38 N, R 90 W, was completed as a shut-in gas well after testing the Fort Union Formation (Tertiary). The potentially productive sand thickness was 160 feet. The first two confirmation wells were completed for gages of 24.7 and 4.3 million cubic feet of gas per day.

Also significant was the Sugar Creek field discovery by Tenneco Oil Co. The discovery well, No. 1 USA-Trowbridge, SW¼ SW¼ sec 26, T 19 N, R 90 W, Carbon County, was completed as a dual producer from the Frontier Formation (Cretaceous) and the Tensleep Formation (Pennsylvanian). Daily flow gage from the Frontier was 1.4 million cubic feet of gas, and from the Tensleep was 4.1 million cubic feet of gas and 72 barrels of condensate. The well went to a total depth of 11,381 feet; top of the Frontier was at 7,506 feet, and of the Tensleep at 10,488 feet.

Other gas activity included a new pay discovery in the Smith Ranch field and an extension to the South Baggs field.

In August Montana-Dakota Utilities Co. received authority from the Public Service Commission to build a gas pipeline from the Recluse field to its Belle Fourche, S. Dak., compressor station; estimated cost of the line was $2.1 million, of which $896,000 would be spent in Wyoming. McCulloch Gas Transmission Co. constructed a 42-mile, 6-inch gas pipeline from the Recluse field to the town of Gillette, plus a 15-mile extension to the Rozet field; the company also built a 10-mile pipeline from the Kitty field to a point on the Recluse line about 12 miles north of Gillette. Combined cost of the McCulloch construction was estimated at $750,000.

Natural Gas Liquids.—Output of natural gas liquids declined 3.9 percent to 6.2 million barrels; output value declined slightly less (3.6 percent) to $13.6 million. Production of LP gases was down 222,000 barrels; natural gasoline output was down 30,000 barrels. Daily throughput capacity of the 27 gasoline plants was 1.03 billion cubic feet of gas rather than the 2.1 billion cubic feet incorrectly reported in 1967.[7] AGA and API reserve estimates of natural gas liquids were 85.0 million barrels, a decrease of 2.3 million barrels.

Three new gasoline plants were planned or under construction at yearend. Sinclair Oil & Gas Co., as operator for itself and nine other companies, was nearing completion of a two-plant complex in the Recluse and Kitty fields. The Recluse field plant will have a daily capacity of 30 million cubic feet of gas; the recovered liquids will be moved by pipeline to the main plant at Kitty field, near Gillette. With a daily capacity of 10 million cubic feet of gas, the main plant will have an estimated daily output of 210,000 gallons of propane, butane, and natural gasoline.

Apache Gas Products Co. was planning a compression-type gasoline plant at the Recluse field. With a daily throughput capacity of 7.5 million cubic feet of gas, the plant was to produce 30,000 gallons of propane and 20,000 gallons of natural gasoline per day.

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[6] American Gas Association, Inc., American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada as of Dec. 31, 1968. V. 23, May 1969, p. 120.

[7] Oil and Gas Journal. V. 66, No. 13, Mar. 25, 1968, pp. 174–175; v. 67, No. 14, Apr. 7, 1969, pp. 144, 146.

Oil Shale.—The Bureau of Mines, through its Laramie Petroleum Research Center, awarded a $92,630 contract to Silver Engineering Works, Inc., Denver, Colo., for the design and fabrication of a 150-ton batch retort. The retort will be used for studying the retorting characteristics of ungraded shale such as that expected in a "chimney" caused by a nuclear explosion. Completion is expected in early 1969.

In an experiment to study in situ combustion of oil shale, the Research Center twice detonated 300-quart charges of nitroglycerine in sand-propped fractures at Rock Springs Site No. 4. The original fractures were induced by combined electrolinking and hydraulic fracturing techniques. At yearend the fractures had been cleaned out and preparations were being made to ignite the shale. The Bureau of Mines released data on one of its coreholes in Report of Investigations 7172.[8]

Petroleum.—Output of crude petroleum increased 5.8 percent over the 136.3 mil-

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[8] Twelfth work cited in footnote 5.

Table 6.—Oil and gas well drilling in 1968, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Albany	-------	-------	2	2	2,182
Big Horn	-------	-------	5	5	35,001
Campbell	25	1	218	244	1,927,926
Carbon	-------	4	16	20	110,086
Converse	2	-------	11	13	80,708
Crook	2	-------	56	58	194,256
Fremont	2	1	19	22	113,876
Goshen	-------	-------	12	12	75,790
Hot Springs	-------	-------	9	9	41,309
Johnson	-------	-------	5	5	32,799
Laramie	-------	-------	13	13	108,660
Lincoln	-------	-------	1	1	5,877
Natrona	1	-------	31	32	170,700
Niobrara	-------	-------	14	14	89,565
Park	-------	-------	9	9	49,106
Sheridan	2	-------	11	13	119,181
Sublette	1	-------	3	4	13,009
Sweetwater	-------	1	19	20	96,184
Uinta	-------	1	2	3	48,761
Washakie	2	-------	9	11	85,134
Weston	1	-------	9	10	59,199
Total	38	8	474	520	3,459,309
Development completions:					
Albany	1	-------	-------	1	5,968
Big Horn	24	-------	7	31	104,799
Campbell	196	2	108	306	2,377,010
Carbon	-------	12	4	16	76,761
Converse	5	1	5	11	75,354
Crook	8	-------	7	15	64,405
Fremont	23	6	14	43	178,760
Hot Springs	3	-------	1	4	16,661
Johnson	1	-------	-------	1	9,150
Laramie	1	-------	4	5	38,786
Lincoln	-------	2	-------	2	8,703
Natrona	47	2	10	59	167,411
Niobrara	1	-------	2	3	11,742
Park	54	-------	5	59	250,926
Sheridan	4	-------	-------	4	32,895
Sublette	6	9	4	19	98,147
Sweetwater	44	7	9	60	338,506
Washakie	23	-------	6	29	284,217
Weston	36	1	31	68	224,651
Total	477	42	217	736	4,364,852
Total all drilling	515	50	691	1,256	7,824,161

Source: Adapted from Petroleum Information Corp., 1968 Résumé, Oil and Gas Operations in the Rocky Mountain Region.

Table 7.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1967	1968	Principal fields in 1968 in order of production
Albany	446	424	Quealy.
Big Horn	7,455	8,012	Garland, Byron, Torchlight, Sage Creek, Bonanza.
Campbell	10,670	19,326	Recluse, Kitty, Raven Creek, Sandbar, M-D, Timber Creek.
Carbon	2,785	2,544	Wertz, Rock River.
Converse	4,441	3,740	Glenrock South, Big Muddy.
Crook	4,690	4,144	Coyote Creek, Donkey Creek, Moorcroft West, Semlek.
Fremont	11,718	11,295	Winkleman, Beaver Creek, Steamboat Butte, Big Sand Draw, Sheldon Dome.
Goshen	7	5	Torrington.
Hot Springs	16,803	16,102	Hamilton Dome, Grass Creek, Little Buffalo Basin, Murphy Dome.
Johnson	7,860	5,949	Sussex, Meadow Creek, North Fork, Sussex, West Dugout, Reno.
Laramie	605	680	Golden Prairie, Horse Creek.
Natrona	18,033	18,474	Salt Creek, Cole Creek, Grieve, Burke Ranch.
Niobrara	760	646	Lance Creek.
Park	33,536	35,912	Elk Basin, Oregon Basin, Frannie, Pitchfork.
Sheridan	409	428	Ash Creek South, Ash Creek.
Sublette	3,922	3,915	Hogsback, McDonald Draw, Birch Creek, Green River Bend.
Sweetwater	7,472	7,590	Lost Soldier, Patrick Draw, Arch Unit.
Uinta	[1] 45	[1] 55	Church Buttes.
Washakie	1,892	2,064	Cottonwood Creek, Hidden Dome.
Weston	2,763	2,945	Fiddler Creek, Osage, Skull Creek, Mush Creek.
Total	136,312	144,250	

[1] Represents 90 percent of production from Church Buttes field; remainder of production included in Sweetwater County.

Source: Wyoming Ad Valorem Tax Division, State Board of Equalization.

lion barrels produced in 1967; value of production increased 8.2 percent. The increases resulted from the high level of activity in the Powder River basin and from slight increases in crude oil prices. Cumulative production to the end of 1968 reached 3.03 billion barrels. Accounting for 66 percent of total mineral production value, petroleum continued to be the most valuable single mineral commodity.

The State had 28 oilfields which produced more than 1 million barrels of oil each during the year; these fields accounted for 106.5 million barrels, 74 percent of the total production. The top three fields were ranked as in 1967—Elk Basin, Park County, ranked first with 17.2 million barrels; Salt Creek, Natrona County, was second with 14.2 million barrels; and Oregon Basin, Park County, was third with 13.5 million barrels. All three fields had higher output than during the previous year. Fourth-ranking oilfield was the old Hamilton Dome field, Hot Springs County, with 6.04 million barrels. A measure of the activity in the Powder River basin was the performance of Recluse field, Campbell County. Discovered in August 1967, the field produced 236,743 barrels by yearend; in 1968, with an output of 6.01 million barrels, it ranked fifth in production. Three of the five largest fields were in the Big Horn basin.

The nine operating refineries in the State processed 43.1 million barrels of crude petroleum; 42.2 million barrels were received at refineries from Wyoming sources and 1.1 million were from out of State. Crude oil shipped out of State totaled 117.1 million barrels; of this, 33.4 million barrels went to Indiana, 20.1 million to Montana, and 14.2 million to Illinois. The refineries had a combined calendar-day throughput capacity of 132,900 barrels.[9]

The former Mobil Oil Corp. refinery in Casper, closed in December 1966, was purchased by Little America Stations, Inc., and reopened in June. With a daily crude oil capacity of 13,500 barrels, the plant provides 100 full-time jobs and an annual payroll of $1 million.

Other refining activity included the expansion of capacity of the Sage Creek Refining Co. plant at Cowley from 500 to 1,000 barrels of crude oil per day.

API and AGA[10] oil reserve estimates as of January 1, 1969, gave total proved reserves of 1.1 billion barrels, an increase of 57.8 million barrels. New fields and

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[9] Oil and Gas Journal. V. 67, No. 12, Mar. 24, 1967, p. 134.

[10] Pages 26–27 of work cited in footnote 6.

Table 8.—Oil and gas discoveries in 1968

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks
			Section	Township	Range				Barrels of oil per day	Thousand cubic feet of gas per day		
Campbell:												
Wildcat	No. 32–27 Superior-Raitt.	U.S. Natural Gas Corp.	27	47 N	70 W	Minnelusa	9,932–9,934	10,173	319	-----	May 11	Pumping. Combined with Yellowhammer field.
Bishop Ranch, South.	No. 1 Government-Bumgardner.	Wessely Petroleum Co.	25	48 N	70 W	do	9,246–9,266	9,390	610	-----	Aug. 3	Pumping.
May	No. 1 State	May Petroleum Co.—W. R. Mais.	16	49 N	69 W	do	8,384–8,449	8,457	331	-----	Dec. 27, 1967	Do.
Wildcat	No. 1 Sinclair-McCulloch.	Sinclair Oil & Gas Co.	4	50 N	73 W	Muddy	8,804–8,834	8,871	214	-----	July 30	Flowing. Combined with Kitty field.
Kingsbury Creek	No. 1-A State-Lowery.	Jack M. Johnston.	15	50 N	74 W	do	9,468–9,475	9,623	323	-----	Oct. 16	Flowing.
Springen Ranch	No. 1 Springen	Pan American Petroleum Co.	27	51 N	71 W	do	7,487–7,491	9,350	144	-----	Nov. 8	Pumping.
Wildcat	No. 16–1 Daly	Consolidated Oil & Gas, Inc.	16	51 N	73 W	do	8,532–8,594	8,700	120	-----	Sept. 8	Flowing. Combined with Daly field.
Do	No. 1 Daly et al.	do	29	51 N	73 W	do	8,966–8,984	9,100	923	-----	July 18	Flowing. Combined with Herman field.
Jamison Prong	No. 1 Wiloth-Federal.	Sinclair Oil & Gas Co.	32	52 N	73 W	do	8,817–8,842	10,575	113	----	Nov. 13	Flowing.
Grassland	No. 1 Harris	Ames Oil & Gas Co.	3	53 N	70 W	Minnelusa	7,458–7,465	7,691	313	-----	Dec. 15	Pumping.
Gas Draw	No. 19–11 Harrington-Federal.	Stuarco Oil Co., Inc.—Bel Oil Corp.	19	54 N	72 W	Muddy	7,314–7,324	7,433	1,200	-----	Aug. 20	Flowing.
Flat Draw	No. 1 Miami-Federal 430.	Miami Oil Producers, Inc.—States Oil Co.	27	54 N	74 W	do	8,064–8,078	8,470	775	-----	May 5	Do.
Wildcat	No. 6–1 Wilson	Petro-Lewis, Ltd.—Ladd Petroleum Co.	6	55 N	73 W	do	7,531–7,540	7,577	157	-----	Dec. 11	Pumping.

Whitetail	No. 1 Ames-Federal 789.	United States Smelting Refining and Mining Co., et al.	9	56 N	72 W	do	6,757–6,765	7,176	900	-----	May 16	Flowing.
Chan	No. 2 Aztec-Government.	Chandler & Associates—Petroleum, Inc.	17	56 N	73 W	do	7,035–7,039	7,150	168	-----	Oct. 11	Pumping.
Hunter Ranch	No. 1 Hunter	Davis Oil Co	28	57 N	72 W	do	6,350½–6,354½	6,436	205	-----	Sept. 14	Flowing.
Sandbar, East	No. 1 Unit-Stone-Federal.	do	11	57 N	73 W	do	6,766–6,805	7,161	109	-----	Jan. 23	Pumping.
Sandbar, West	No. 1 Unit-Swanson-Federal.	do	13	57 N	74 W	do	6,996–7,004	7,428	380	-----	Feb. 29	Do.
Wildcat	No. 1 Federal	Stuarco Oil Co., Inc.	32	57 N	74 W	do	7,450–7,516	7,610	1,045	-----	Jan. 16	Flowing. Combined with Recluse field.
Prep	No. 1 Government-K. Cotter.	Wolf Exploration Co.	7	57 N	75 W	do	7,186–7,209	7,600	495	-----	May 6	Pumping.
Wildcat	No. 44–24 Federal.	U.S. Natural Gas Corp.	24	57 N	75 W	do	7,505–7,520	7,810	811	-----	Apr. 1	Flowing. Combined with Recluse field.
Carbon:												
Wildcat	No. 13–1 Christensen Ranch.	J. M. Huber Corp.	13	12 N	93 W	Lewis	4,803–4,814	6,760	-----	2,230	Sept. 4	Flowing. Combined with Baggs, South field.
Smith Ranch	No. 1–A Balta	Wolf Exploration Co.	17	12 N	93 W	Lance	5,050–5,068	7,704	-----	1,400	Sept. 16, 1967	Flowing. New pay.
Sugar Creek	No. 1 USA-Trowbridge.	Tenneco Oil Co	26	19 N	90 W	Frontier Tensleep	7,754–7,778 10,506–10,512	11,381	-----	5,612	Sept. 13	Flowing.
Crook: Wood, South	No. 2 State-Wood.	Mountain Minerals.	25	51 N	68 W	Butler	4,906–4,918	5,198	400	-----	Nov. 11	Pumping.
Fremont: Madden	No. 1 Madden Deep Unit.	Wolf Exploration Co.	2	38 N	90 W	Ft. Union	7,465–7,476 7,750–7,760 8,176–8,186	10,020	-----	-----	Aug. 12	Shut-in gas well.
Natrona: Geary, North	No. 1 North Geary-Federal.	Exeter Drilling Co.	22	34 N	78 W	Muddy Dakota	6,450–6,454 6,579–6,583	6,680	117	-----	Mar. 22	Pumping.
Sheridan:												
Fence Creek	No. 1 Bridwell-Federal.	Clyde G. Kissinger.	32	58 N	76 W	Muddy	7,709–7,715	8,152	[1] 444	-----	Nov. 23	Do.
Remington	No. 1 Federal-Harden.	Jul-Tex Drilling Co.	35	58 N	77 W	do	8,116–8,136	8,500	256	-----	May 31	Flowing.
Uinta: Church Buttes	No. 19 Unit	Mountain Fuel Supply Co.—Union Pacific Railroad Co.	8	16 N	112 W	Morgan	18,050–18,200	19,526	310	6,400	Dec. 28, 1967	Flowing. New pay.

See footnotes at end of table.

Table 8.—Oil and gas discoveries in 1968—Continued

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks
			Section	Township	Range				Barrels of oil per day	Thousand cubic feet of gas per day		
Washakie:												
No Water Creek..	No. 2 No Water Creek Unit.	Tenneco Oil Co..	6	46 N	91 W	Phosphoria..	10,932–10,998	11,105	256	-----	Mar. 10	Pumping.
Rattlesnake.......	No. 1 USA-Faure.	----do..........	11	47 N	92 W	----do......	10,852–10,999	11,827	372	-----	June 21	Flowing.
Weston: Wildcat......	No. 1 U.S. Smelting-Government.	Wm. L. Dugger, Jr., Inc.	34	45 N	63 W	Newcastle...	3,720–3,729	3,835	250	-----	Jan. 18	Flowing. Combined with Mush Creek field.

[1] Completed for 444 barrels of oil on a 22-hour pump test.
Source: Petroleum Information Corp., 1968 Résumé, Oil and Gas Operations in the Rocky Mountain Region.

pools added 21.7 million barrels; revisions and extensions added 178.7 million. Additional reserves of 120.3 million barrels were considered available by fluid injection.

Drilling in the State reached an alltime record. The 1,256 wells completed were 331 (36 percent) more than for 1967. Exploratory drilling increased from 428 wells in 1967 to 520 in 1968—an increase of 21.5 percent. The exploratory wells exceeded the previous record of 445 wells (in 1966) by 17 percent. Development drilling increased 48 percent over that of 1967. Footage drilled was at a new high; average well-depth was 6,229 feet. Wildcat success ratio was 8.8 percent, compared with 16.6 percent for the previous year; there were 38 oil and eight gas discoveries.

Accounting for 44 percent of all drilling, Campbell County, with 550 wells, had the largest number of both wildcat and field wells. Its exploratory success ratio was 10.7 percent. Crook County had 58 wildcat wells drilled; only two were successful.

Development drilling programs in the Recluse and Kitty fields were successful. By yearend Recluse had 88 producing wells and Kitty had 50 (the Kitty field included the Kitty-Daly-Herman complex). In the Patrick Draw field, Sweetwater County, 43 new field wells were completed. An unusual occurrence was in the old Torchlight field where 13 wells were completed in the Madison (Mississippian) pool. Two of the development wells had daily flow gages of approximately 4,000 barrels of oil, whereas the earlier Madison wells (drilled in the late 1940's) were completed for initial potentials of 486 barrels per day or less.

The great interest in the Muddy Formation (Cretaceous) in the Powder River basin made that area the most active onshore oil region in the State and the rest of the Nation. On the basis of their initial potential, the most significant discoveries also were in that area.

Stuarco Oil Co., Inc., and Bel Oil Corp. discovered the Gas Draw field with the successful completion of their Harrington-Federal No. 19–11 well, sec 19, T 54 N, R 72 W, Campbell County. The well was completed flowing 1,200 barrels of oil per day from the Muddy at 7,314 to 7,324 feet. By yearend the field had 12 successful completions and seven wells were drilling; production for the year was 353,645 barrels of oil.

The Whitetail field was found by completion of the Ames-Federal No. 1 well, sec 9, T 56 N, R 72 W, Campbell County, drilled by the United States Smelting Refining and Mining Co. and others. The well had a daily flow gage of 900 barrels of oil from the Muddy interval 6,757 to 6,765 feet; 14 wells were producing by yearend.

Eleven miles south of the Recluse field, Miami Oil Producers, Inc., and States Oil Co. discovered the Flat Draw field. The discovery well, Miami-Federal No. 1, sec 27, T 54 N, R 74 W, Campbell County, was completed for a flow gage of 775 barrels of oil per day from the Muddy. Confirmation wells, however, were unsuccessful.

Davis Oil Co. completed two significant discoveries in Campbell County. They found the East and West Sandbar fields northeast of Recluse. The Unit-Stone-Federal No. 1, sec 11, T 57 N, R 73 W (East Sandbar) was completed for 109 barrels of oil per day from the Muddy Formation; by yearend the field had five producing wells. The Unit-Swanson-Federal, sec 13, T 57 N, R 74 W (West Sandbar), had a daily completion gage of 380 barrels of oil; this field had 25 producing wells by yearend.

Outside the Powder River basin the most significant discovery was the "new pay" discovery of Mobil Oil Corp. in the Hogsback field, in the Green River basin, Sublette County. The field previously had produced oil or gas from the Frontier, Muddy, and Bear River Formations (Cretaceous) and from the Nugget Formation (Jurassic). Mobil completed its Hogsback No. 44–31, sec 31, T 27 N, R 113 W, for a daily flow gage of 1,130 barrels of oil from the Dakota (Cretaceous) and 1,295 barrels from the Nugget. A confirmation well tested the Dakota at an estimated rate of 4,765 barrels of oil per day.

Because of the great increase in activity and production in the Powder River basin (both in Wyoming and Montana), many new pipelines and additions to existing lines were built or planned during the year.

The Permian Corp., in February, completed a 111-mile, 10¾-inch pipeline from Bell Creek field (Montana) to the Reno field where it joined the Service Pipe Line Co. system; three 6-inch laterals connect the trunkline to gathering systems in the Recluse and Kitty fields. At completion the line was taking 43,500 barrels of oil per day.

Belle Fourche Pipeline Co. constructed a 6-inch line from Recluse field to its Camp Creek station and a 200-mile line from Donkey Creek to Fort Laramie. The latter is a 12¾-inch line with capacity of 50,000 barrels of oil per day and provides connections with Service Pipe Line Co., Platte Pipe Line Co., and Continental Pipe Line Co.

Butte Pipe Line Co. announced plans for expanding its facilities in eastern Wyoming. Three new pump stations to be built would, with additions to existing stations, increase the system's daily capacity to 143,000 barrels.

Service Pipe Line Co. announced plans to increase the capacity of its system from 200,000 to 255,400 barrels of oil per day. Plans included 23 miles of 16-inch line from Midwest to near Casper; four new pump stations with a total of 9,000 horsepower; and additional power at stations at Reno, Salt Creek, Casper, La Bonte, Fort Laramie, and La Grange. Service also planned to modernize facilities in southwestern Wyoming at Wamsutter.

NONMETALS

Nonmetals accounted for 12 percent of the value of the State's total mineral production. The various minerals contributing to this category are cement, clays, feldspar, gem stones, gypsum, lime, phosphate rock, sand and gravel, sodium carbonate, sodium sulfate, and stone.

Cement.—Shipments from the State's only producer, Monolith Portland Midwest Co., increased substantially in the portland cement category (41 percent in value and 40 percent in quantity); masonry cement, however, decreased 5 percent in value and 17 percent in quantity.

Clays.—Clay production, constituting almost 25 percent of the value of all nonmetals, was second in value of the nonmetals. Production increased substantially in 1968 to 1.8 million tons valued at $17.3 million from 1.5 million tons and $14.3 million in 1967. The $3 million increase was 21 percent over the value of last year. Bentonite production again had the largest share of the clay market with only relatively small amounts contributed by fire clay and miscellaneous clays. Wyoming continues to be the Nation's leading producer of bentonite. The bentonite consumed in rotary drilling led the list of uses of clays in the State—27.5 percent of the total clay production. Iron ore pelletizing, formerly the leading use, dropped to second place in 1968 with nearly 26 percent of the market. Using 25 percent, the foundry industry moved down from second to third place.

Clay was obtained from 16 mines in Big Horn, Crook, Johnson, Natrona, Uinta, and Weston Counties and by such companies as American Colloid Co., Ashland Chemical Co., Benton Clay Co., Inc., Black Hills Bentonite Co., Dresser Industries, Inc., International Minerals & Chemical Corp. (IMC), International Pipe and Ceramics Corp., Interstate Brick Co., National Lead Co., The Lovell Clay Products Co., and Wyo-Ben Products, Inc.

Feldspar.—A small increase was recorded in the quantity of feldspar produced but valuation doubled as more feldspar was shipped to manufacturers of dental products, increasing the average selling price. Production from the same two mines continued to provide the State output. Rocky Mountain Aggregates, Inc., in Albany County, produced feldspar for use as precast stone and IMC, in Natrona County, for use in dental products.

Gypsum.—Gypsum registered the largest percentage increase in quantity and value for the entire mineral industry of the State. An 84-percent gain in quantity was due largely to the first full year of production from the mine of Gypsum Division, Georgia-Pacific Corp. (G–P), for use in its wallboard plant at Lovell. The 158-percent jump in value was a result of increased production and price.

Wyoming Construction Co. produces ore near Woods Landing for the cement plant of Monolith Portland Midwest Co. at Laramie in Albany County. G–P mines gypsum and produces lath, wallboard, and sheathing at Lovell in Big Horn County. The State's third operation is Big Horn Gypsum Co. at Cody in Park County. Its production also is used for lath, wallboard, and sheathing.

The new G–P plant at Lovell went into production early in the year, with an annual capacity of 80 million square feet of calcined-gypsum products.

Lime.—Quicklime was produced at an increased tempo for the refining of beet sugar by The Great Western Sugar Co., subsidiary of Great Western United Corp., in a plant at Lovell and by Holly Sugar Corp. in plants at Torrington and Worland. The Great Western plant at Lovell enlarged its plant facilities to include new pulp handling and pelletizing equipment and a 12,500-ton pellet warehouse. The Holly Sugar Corp. plant at Worland will increase beet slicing capacity from 1,700 tons to 2,000 tons per day when completed in fall 1969.

Phosphate Rock.—Output of phosphate rock by the State's only producer, San Francisco Chemical Co., declined 31 percent in quantity and 29 percent in value. Ores from Wyoming and Utah were processed at its plant at Sage in Lincoln County. Principal sales of the product are as phosphoric acid and superphosphate. A large part of the total production is exported.

Sand and Gravel.—Third in value among the nonmetals was sand and gravel. Output increased 14 percent and value increased 9 percent over that of 1967. Value of production was up $720,000 to $8,973,000, with an increase of 1,169,000 tons to 9,350,000 tons total. Average prices continued the drop started in 1966, when the average was $1.04 per ton. In 1968 the average price was 96 cents per ton, down 5 cents from the 1967 average. Output was reported from 82 commercial operations and 79 Government-and-contractor operations representing all counties. Reports show 94 percent of the sand and gravel was prepared for use by washing, crushing, or screening; the remaining 6 percent was used as pit run. Distribution, according to use, was 76 percent for road construction, 14 percent for fill, 5 percent for railroad ballast, 4 percent for building, and 1 percent for miscellaneous. Output, in descending order of production, was highest in Washakie, Albany, Johnson, and Park Counties. Companies reporting the largest output of sand and gravel, in alphabetical order, were Big Horn Construction Co., Brasel & Sims, Gilpatrick Construction Co., Inc., Knisely-Moore Co., O. B. Forgey Construction Co., Union Pacific Railroad Co., and Yost Crane & Dragline Service.

Sodium Carbonate.—Production of sodium carbonate (trona), the most valuable nonmetal mined in the State, increased 26 percent in quantity and 9 percent in value.

In late November Allied Chemical Corp. completed a $25 million complex near Green River to produce over 600,000 tons of soda ash annually. Completion of the new plant is expected to make the company the Nation's largest soda ash producer. Church & Dwight Co., Inc., started production runs at yearend of bicarbonate and sal soda products from a $5 million plant located about 25 miles west of Green River. The plant uses trona from the adjacent Allied Chemical Co. mine. FMC Corp., the largest and oldest trona-mining operation in the State, noted a steady increase in production. Stauffer Chemical Company's shipments of soda ash to glass container firms were interrupted briefly early in the year by a strike in the glass

Table 9.—Sand and gravel production in 1968, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Albany	1,054	$802	Park	773	$855
Big Horn	54	67	Platte	181	181
Campbell	W	W	Sheridan	580	652
Carbon	631	648	Sublette	219	272
Converse	12	7	Sweetwater	609	590
Crook	81	113	Teton	120	137
Fremont	615	732	Uinta	435	429
Goshen	W	W	Washakie	1,407	796
Hot Springs	24	27	Weston	78	78
Johnson	779	814	Yellowstone National Park	28	37
Laramie	364	289	Undistributed	506	601
Lincoln	162	125			
Natrona	442	528	Total	9,350	8,973
Niobrara	196	193			

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Table 10.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1967		1968	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	131	$186	189	$259
Paving	95	115	113	173
Fill	48	52	[1]20	[1]25
Other	-------	-------	(1)	(1)
Total	274	353	322	457
Gravel:				
Construction:				
Building	156	221	198	280
Paving	627	633	2,240	2,530
Railroad ballast	-------	-------	446	162
Fill	41	25	1,289	660
Other	-------	-------	5	6
Miscellaneous	52	44	81	94
Total	876	923	4,259	3,732
Total sand and gravel	1,150	1,276	4,581	4,189
Government-and-contractor operations:				
Sand:				
Building	-------	-------	1	3
Paving	2,921	2,921	1,952	1,948
Fill	9	2	-------	-------
Total	2,930	2,923	1,953	1,951
Gravel:				
Building	3	3	3	5
Paving	4,086	4,042	2,783	2,800
Fill	12	9	30	28
Total	4,101	4,054	2,816	2,833
Total sand and gravel	7,031	6,977	4,769	[2]4,784
All operations:				
Sand	3,204	3,276	2,275	2,408
Gravel	4,977	4,977	7,075	6,565
Total	8,181	8,253	9,350	8,973

[1] Fill and "Other" sand combined to avoid disclosing individual company confidential data.
[2] Final figure; supersedes figure given in Commodity chapter.

container industry. Plant expansion is scheduled by Stauffer to increase production capacity to 950,000 tons of soda ash by 1970. TGS, through Winston Brothers Co. as contractors, sank a 16-foot-diameter shaft to 1,100 feet by yearend on its lease 8 miles northeast of Granger. The shaft is expected to be completed by the end of 1969. Preliminary plant engineering and design studies of the processing facilities continued.

Sodium Sulfate.—Sodium sulfate shipments increased 5 percent in quantity and 4 percent in value. William E. Pratt made shipments from saline-lake deposits in Natrona County.

Stone.—Increases in the quantity and value of stone shipments in 1968 reversed the downward trend that started in 1965. Shipments increased 15 percent in quantity to 1.4 million tons from 1.2 million in 1967 and value 16 percent to $2.8 million from $2.4 million. Output was from 42 operations in 16 counties. Crushed and broken stone comprised 99.9 percent of all production. The remaining 0.1 percent was dimension sandstone used for constructing buildings, rubble, and decorative uses. Crushed limestone and granite made up 72 percent of the total production, with lesser amounts of traprock, dolomite, marble, quartzite, sandstone, and other stone.

Counties that led in stone production, in order of output, were Laramie, Albany, Platte, Yellowstone National Park, and Teton. Principal uses of stone were for railroad ballast, in making cement and lime, and as dense-graded roadbase and concrete aggregate. Crushed and broken stone was produced in the following counties: Limestone in Albany, Crook, Laramie, and Teton; dolomite and marble in Platte; granite in Fremont and Laramie; sandstone in Albany and Carbon; quartzite in Albany; traprock in Park, Teton, and Yellowstone National Park; and other stone in Albany, Carbon, Fremont, Goshen, Hot Springs, Johnson, Natrona, Niobrara, Park, Platte, Sheridan, and Sweetwater.

Table 11.—Stone production in 1968, by counties

County	Short tons	Value
Albany	W	W
Carbon	39,159	$103,472
Crook	3,100	6,200
Fremont	27,904	41,854
Goshen	405	608
Hot Springs	262	393
Johnson	1,072	1,608
Laramie	W	W
Natrona	188	282
Niobrara	304	456
Park	21,895	22,892
Platte	W	W
Sheridan	W	W
Sweetwater	2,832	1,798
Teton	59,000	144,100
Yellowstone National Park	62,900	55,200
Undistributed	1,215,158	2,375,270
Total	1,434,179	2,754,133

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Sulfur.—Elemental sulfur production recovered as a byproduct in the liquid purification of natural gas decreased substantially. Shipments in 1967 were 92,330 long tons but declined 48 percent in 1968 to 48,153 long tons. The drop in value was from $2 million to $960,000 or 52 percent. Much of the decline could be attributed to the closing of the TGS Worland plant, but declines also occurred at some of the remaining plants. The sulfur was recovered by the Claus process at the Sinclair Oil Corp. plant in Carbon County, the Atlantic Richfield Co. plant in Fremont County, and the Purvin & Gertz plant in Park County; by the Modified Claus process at the Pan American Petroleum Corp. plants in Fremont and Park Counties, and the Western Nuclear, Inc., plant in Fremont County; and the Webb process at the Husky Oil Co. plant in Park County.

Kennecott Copper Corp. announced plans to install a 3,000-ton sulfuric acid bulk storage tank facility at Medicine Bow to supply acid to uranium mills in the area. The acid is produced as a byproduct of copper smelting near Salt Lake City, Utah, and will be shipped in 100-ton tank cars.

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Iron Ore.—Although iron ore production increased 6 percent, value remained virtually unchanged (up 1 percent). The four operations in the State are the Atlantic City mine of United States Steel Corp., Fremont County; the Sunrise mine of CF&I Steel Corp. (CF&I), Platte County; and the Chugwater mine of Plicoflex, Inc., and the Jean mine of Union Pacific Railroad Co., Albany County.

The Sunrise mine produces hematite from an underground mine; the other three produce magnetite from open pits.

Development work by CF&I on the new Columbia Gulch iron deposit, near the Sunrise mine, was nearly completed during 1968; some production was achieved.

Uranium.—A substantial increase in production of 27 percent, to a total of 5,928,172 pounds of U_3O_8, and an increase in value of 19 percent, to $44,343,462, maintained uranium as the second most valuable mineral in the State (after petroleum). Wyoming also maintained second place nationally in the production of uranium oxide.

The rapid regrowth and expansion of the uranium industry that began in 1966 continued. The largest single new industrial complex announced for the State in 1968 was the $20 million uranium mining and milling facility to be built in the Shirley basin by Utah Construction & Mining Co. Construction will begin in 1969 and the mill will begin operations in late 1970 or early 1971, with a capacity of approximately 2,250,000 pounds of uranium annually. The new mill will be about the same size as the company's Lucky Mc mill in the Gas Hills—the largest mill presently operating in the State. The company contracted in 1968 for the sale of over 2,450,000 pounds of uranium concentrates to be delivered through 1975. Companies

Table 12.—Contracts for private uranium sales in Wyoming

Owner	Purchaser	Thousand pounds	Value (thousands)	Delivery date
Federal American Partners	American Electric Power Co., Inc	-------	$5,000	1969–70
	Babcock & Wilcox Co. (Virginia)	-------	4,800	1969–70
	Combustion Engineering, Inc	-------	9,000	1970–71
Union Carbide Corp., Mining and Metals Division.	Northern States Power Co. (Minneapolis).	700	-------	(1)
	Westinghouse Electric Corp	4,000	-------	1970–73
Utah Construction & Mining Co., Lucky Mc Division.	Carolina Power & Light Co	2,200	-------	1971–76
	General Electric Co	1,700	-------	1969–70
	do	5,000	-------	1971–75
	do	1,000	-------	1972
	Nordostschweizerische Kraftwerke A.G.	-------	3,250	(2)
	Oskarshamnsverkets Kraftgruppe Aktiegelag.	765	-------	(3)
	Sacramento Municipal Utility District	1,100	-------	1971
	do	1,000	-------	1971–75
Western Nuclear, Inc	Combustion Engineering, Inc	3,500	-------	1971–73
	Philadelphia Electric Co	300	-------	(3)
	Public Service Electric & Gas Co. (Philiadelphia).	500	-------	(3)
	Westinghouse Electric Corp	1,000	-------	1970

[1] To begin 1970.
[2] Being delivered.
[3] Completed 1968.

Source: The Riverton Ranger, v. 63, No. 78, June 19, 1969, p. 9.

receiving the shipments are Sacramento Municipal Utility District, General Electric Co., and Nordostschweizerische Kraftwerke A. G., a Swiss company. During the year Kerr-McGee made its first deliveries of uranium concentrates to the commercial market and had a backlog of over $500 million in orders. The Petrotomics mill—a joint venture of Getty Oil Co., Skelly Oil Co., and Kerr-McGee Corp., operated by Getty Oil—increased capacity in June to 1,000 tons per day and planned a 500-ton-per-day expansion for 1969. The expansions are to accommodate ores from Kerr-McGee's new uranium mine, Another joint venture involved Getty Oil Co. and Skelly Oil Co. The companies made preliminary plans for a new uranium mine and mill complex in the Shirley basin area. The two joint ventures are separate operations. Kerr-McGee announced the construction of a uranium mining and milling complex north of Douglas.

Kerr-McGee also had a new mine underway in the Shirley basin with production scheduled to begin in 1970. Early in the year Kerr-McGee announced a major uranium discovery about 45 miles north of Casper in the Southern Powder River basin. Union Carbide Corp. and Federal American Partners are making feasibility studies of the expansion of uranium operations in the Gas Hills area. Western Nuclear, Inc., stripping overburden from the D–3 mine in the Gas Hills, expects to be in production by late 1969.

Continuing at an accelerated rate, exploration for new uranium reserves was one of the most active facets of the entire mineral industry in Wyoming. According to the U.S. Atomic Energy Commission, 12 million feet of exploration and development drilling was completed in the State during the year; nationally, 50.5 percent of all uranium drilling took place in Wyoming. Golden Cycle Corp. and Congo Uranium Co. entered a joint agreement to explore 18,000 acres of unpatented mining claims in Fremont and Sweetwater Counties. Golden Cycle and Western Standard Uranium, Inc., known as Cycle-Westan Partners, also joined in a similar type venture to explore 10,000 acres in the Shirley basin. New Park Mining Co. purchased a 50-percent interest in 2,300 acres of mining claims and optioned 50 percent of an adjoining 2,300 acres in the Crooks Gap area. Silver Bell Mines Co. and W. R. Grace & Co. entered an agreement to explore on 923 claims comprising 18,000 acres in the Crooks Gap area. Union Carbide Corp. leased another 125 claims from Vipont Mining Co., bringing the total leased to 304 claims. Atlantic Richfield

Co. purchased over 500 claims in the Shirley basin from American Nuclear Corp. An option for exploration rights by Atlantic Richfield was also extended by American Nuclear for 1,500 additional claims in the same area. Western Nuclear was doing exploration in the Jeffrey City area, and Union Pacific Railroad Co. in the Powder River basin. Atlas Minerals Division, Atlas Corp., was also conducting exploration in the State.

Involving underground water rights, seepage, and air pollution, a lawsuit brought by landowners adjacent to the uranium mill and sulfuric acid plant near Riverton was settled with the payment to the landowners of $50,000 by Susquehanna-Western, Inc., and $12,500 by Western Nuclear. The suit was of interest to the mining industry because of the conflict of rights governing underground water, seepage, and air pollution related to domestic and agricultural interests versus industrial users.

Vanadium.—No vanadium was recovered from the vanadium-bearing uranium ores shipped to Edgemont, S. Dak., for processing.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Cement: Monolith Portland Midwest Co.	Box 65677, Glassell Station Los Angeles, Calif. 90065	Plant	Albany.
Clays:			
American Colloid Co	5100 Suffield Court Skokie, Ill. 60076	Open-pit mine and plant	Big Horn.
		Open-pit mine	Crook.
		Open-pit mine and plant	Weston.
Ashland Chemical Co., Foundry Products Division.	Box 2458 Columbus, Ohio 43216	do	Crook.
		do	Weston.
Black Hills Bentonite Co	Box 1 Mills, Wyo. 82644	do	Johnson.
Dresser Industries, Inc., Dresser Minerals Division.	Box 6504 Houston, Tex. 77005	do	Big Horn.
International Minerals & Chemical Corp., Eastern Clay Products Dept.	Administration Center Old Orchard Road Skokie, Ill. 60079	do	Crook.
National Lead Co., Baroid Division.	Box 1675 Houston, Tex. 77001	do	Do.
		Open-pit mine	Weston.
Wyo-Ben Products, Inc	Box 1979 Billings, Mont. 59103	Open-pit mine and plant	Big Horn.
Coal:			
The Kemmerer Coal Co	Frontier, Wyo. 83121	2 strip mines, crushing and oil treatment plant.	Lincoln.
Pacific Power & Light Co	920 S.W. 6th Avenue Portland, Oreg. 97204	Strip mine	Converse.
Feldspar:			
International Minerals & Chemical Corp., Industrial Chemicals Division.	Administration Center Old Orchard Road Skokie, Ill. 60079	Open-pit mine	Natrona.
Rocky Mountain Aggregates, Inc.	Box 771 Golden, Colo. 80402	do	Albany.
Gypsum: Big Horn Gypsum Co	Box 590 Cody, Wyo. 82414	Open-pit mine and wallboard plant.	Park.
Iron ore:			
CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	Underground mine and beneficiation mill.	Platte.
United States Steel Corp., Western Ore Operations.	Lander, Wyo. 82520	Open-pit mine and agglomerator.	Fremont.
Lime:			
The Great Western Sugar Co.	Box 5308 Denver, Colo. 80217	Shaft kiln at beet-sugar plant.	Big Horn.
Holly Sugar Corp	Holly Sugar Bldg. Colorado Springs, Colo. 80902	do	Goshen.
		do	Washakie.
Natural gas and petroleum:[1]			
Phosphate rock: San Francisco Chemical Co.	Drawer F Montpelier, Idaho 83254	Open-pit mine and beneficiation plant.	Lincoln.
Sand and gravel (commercial):			
Boatright-Smith	Box 1129 Casper, Wyo. 82002	4 pits and plants	Natrona.
Carl E. Nelson Construction Co., Inc.	Box 383 Logan, Utah 84321	Pit and plant	Lincoln.
		do	Sweetwater.
Casper Concrete Co	1525 East F Street Casper, Wyo. 82601	do	Natrona.
Gilpatrick Construction Co., Inc.	Box 973 Riverton, Wyo. 82501	Pit	Campbell.
		2 pits and plants	Fremont.

See footnote at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel (commercial)—Continued			
Gilpatrick Construction Co., Inc.—Continued		Pit	Goshen.
		Pit	Natrona.
		Pit	Park.
		Pit	Sheridan.
		Pit	Sublette.
		Pit	Sweetwater.
McGarvin-Moberly Construction Co.	1509 Coburn Avenue Worland, Wyo. 82401	Pit and plant	Fremont.
		Pit	Park.
		Pit	Sublette.
		Pit	Washakie.
Teton Construction Co	1308 E. Fox Farm Road Cheyenne, Wyo. 82001	Pit and plant	Goshen.
		Pit	Laramie.
		Pit	Niobrara.
Union Pacific Railroad Co	1416 Dodge Street Omaha, Nebr. 68102	Pit	Albany.
Yost Crane & Dragline Service.	914 Culbertson Worland, Wyo. 82401	Pit and plant	Washakie.
Sodium carbonate:			
FMC Corp., Inorganic Chemicals Division.	Box 872 Green River, Wyo. 82935	Underground mine and refinery.	Sweetwater.
Stauffer Chemical Co	Box 513 Green River, Wyo. 82935	do	Do.
Stone:			
The Great Western Sugar Co.	Box 5308 Denver, Colo. 80217	Quarry and plant	Laramie.
Guernsey Stone Co	Guernsey, Wyo. 82214	do	Platte.
Monolith Portland Midwest Co.	Box 65677, Glassell Station Los Angeles, Calif. 90065	2 quarries and plants	Albany.
Union Pacific Railroad Co	1416 Dodge Street Omaha, Nebr. 68102	Quarry and plant	Laramie.
Uranium:			
Federal American Partners	Box 991 Riverton, Wyo. 82501	5 open-pit mines and mill.	Fremont.
Petrotomics Co	Drawer 2450 Casper, Wyo. 82601	Open-pit mine and mill	Carbon.
Utah Construction & Mining Co.	Box 911 Riverton, Wyo. 82501	Leaching operation	Do.
		4 open pit mines, 2 underground mines, and mill.	Fremont.
Western Nuclear, Inc	Jeffrey City, Wyo. 82310	7 underground mines, leaching operation, and mill.	Do.

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[1] Most of the major oil and gas companies and many smaller companies operate in Wyoming and several commercial directories contain complete lists of them.

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